POWER

Vol. 46 NEW YORK, NOVEMBER 27, 1917 No. 22

Going Him One Better

By Rufus J. Strohm

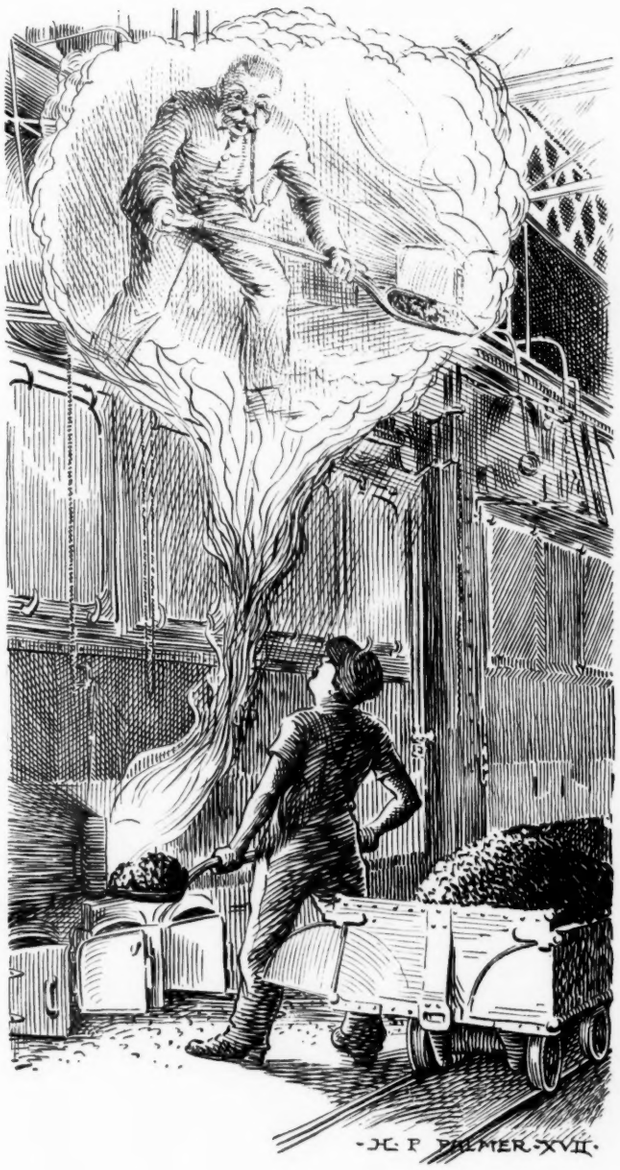
In a steam plant over yonder,
Safe behind the cannon's thunder,
There's an engineer who answers
To the name of Hans or Fritz;
And he earns his bread and gruel
Making power out of fuel,
To produce the shells for blowing
Yankee soldiers into bits.

He is careful in his labors,
For, like all his German neighbors,
Autocrats have made him saving
Ever since the war began;
And there's something worth admiring
In the way he does his firing,
Since he gets from every scoopful
All the energy he can.

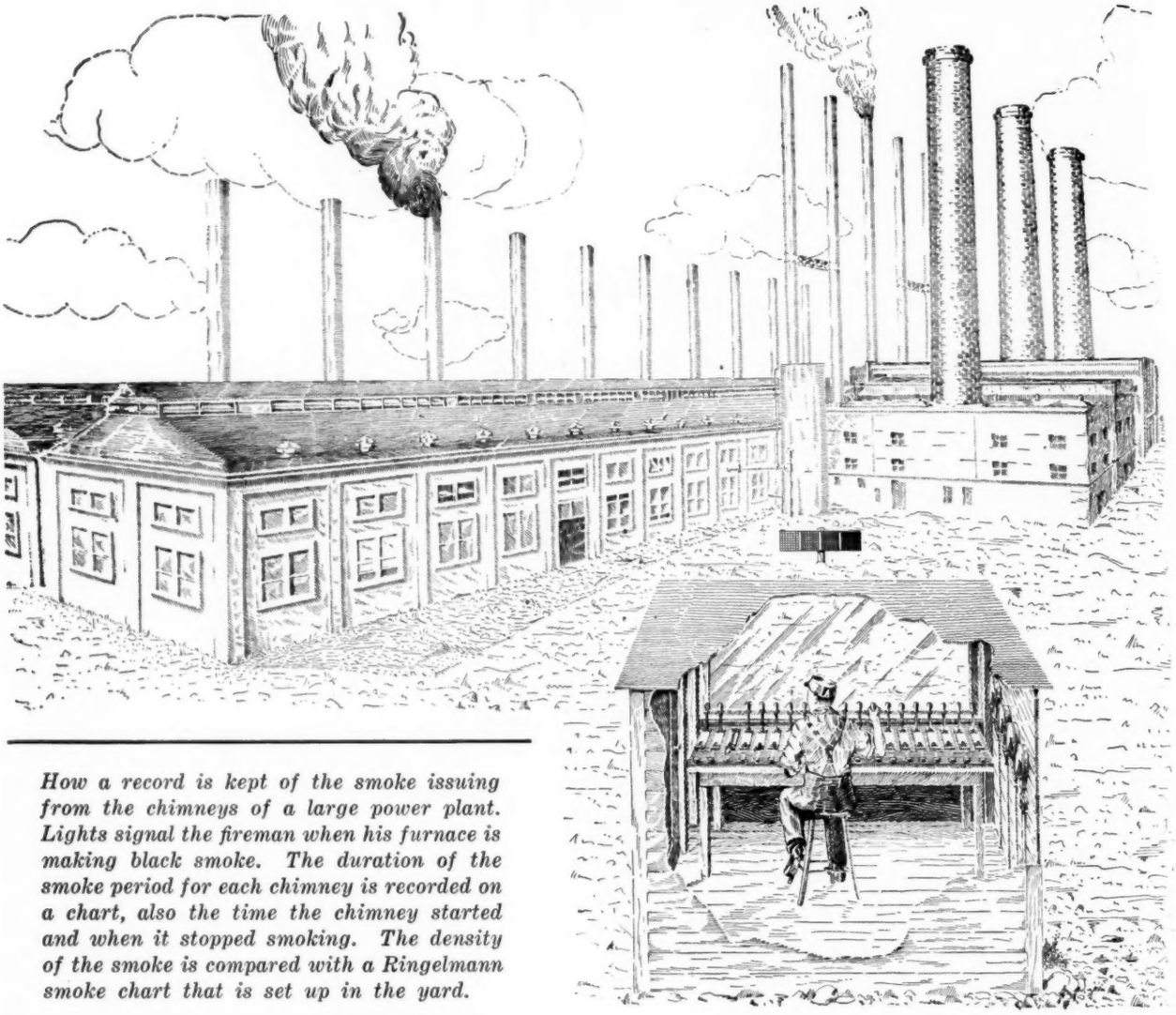
Now, I'm just a common toiler,
Who attends to pump and boiler,
And I'll never serve my country
In the air or on the sea;
Furthermore, my age is forty,
And I'm such a wizened shorty
That I'm positive the army
Wouldn't be the place for me.

But, though I escape the trenches,
With their grim and bloody clenches,
I can fight a silent battle
With that German engineer;
For, if I produce my power
At a smaller cost per hour,
Then it follows that I've licked him
In our narrow little sphere.

So, in every occupation
In the whole of this great nation,
Each of us can aid a little
In the cause we're fighting for;
If we're loyal, to the letter,
And we try to go one better
On the Teuton's best performance,
We can help to win the war.



Controlling Smoking Chimneys



How a record is kept of the smoke issuing from the chimneys of a large power plant. Lights signal the fireman when his furnace is making black smoke. The duration of the smoke period for each chimney is recorded on a chart, also the time the chimney started and when it stopped smoking. The density of the smoke is compared with a Ringelmann smoke chart that is set up in the yard.

THE problem of preventing the belching of smoke from the chimneys of steam-power plants is not one that has given concern during recent years only. Records show that back in the time of King Henry III a proclamation was issued prohibiting the use of coal while parliament was sitting, in order that the knights might not suffer from the effects of the smoke. From the time of Henry III the smoke nuisance and accompanying waste of fuel seem to have kept pace with the growth of industries; so much so that Pittsburgh, Cincinnati, Cleveland and other cities have become famous for their objectionable smoke-producing propensities.

Probably Pittsburgh has had the greatest problem to solve of all the smoke-ridden cities of the country, and yet a solution has been reached, which is good combustion engineering and the proper handling of the furnace fires. Today the improved condition of the city is such as to be almost beyond belief as compared with that of former years. If the improvement is as great during the next ten years and New York City increases the number of smoking chimneys at the rate she has during the last few years, Pittsburgh will then be by far the cleaner city of the two.

The new smoke ordinance recently passed by the City of Pittsburgh will have much to do with the practice of former willful smoke offenders in that those who will not willingly assist in preventing the emission of smoke from their chimneys will be made to do so. On the other hand, there are those who are earnestly endeavoring to assist in the prevention of smoke. Among others is the Duquesne Light Co. at its Brunots Island power station, which is located on an island in the Ohio River.

This station is served by twenty 500-, ten 600- and twenty 823-hp. boilers, a total of 32,460 boiler horsepower, nominal rating. These boilers are served by 18 chimneys arranged as indicated by the accompanying illustration, three of the chimneys, serving the twenty largest boilers, being of brick construction; the others are of steel construction.

Naturally, more or less smoke will come from these chimneys because of the character of coal used and the variable ability of men engaged in operating the boiler

stokers. In order to give the combustion engineer and firemen advance notice of the tendency of any furnace to smoke, a system of electrical signals has been installed, and immediate steps can be taken to correct any conditions that are either causing light smoke or likely to develop, so as to cause heavy smoke if not anticipated by proper manipulation. In brief, the system was designed as an aid in preventing smoke rather than to make a historical record.

In the boiler room above the firing aisle and in line with the smoke uptake of each boiler is a red incandescent lamp inclosed in an opal globe so as to enlarge the glow of the lamp. Each of these lights is independently connected to a switch in the observation house, which is so situated that the observer has a view of all chimneys. The lamp connections are carried to the switches by way of a 20-pair telephone cable placed underground. Each circuit is connected in parallel with a time-recording instrument which indicates the time any particular circuit is closed by throwing in the switch and the time the switch remained in. Connected to the common return line is an indicating ammeter, which indicates whether the lights in the boiler room actually burned or not. In this way a check is had on the fireman if a claim is made that his lamp did not burn when the switch was thrown in.

The Switching System

A partial view of the switchboard is shown in Fig. 1. There are two extra switches, which operate a relay, which in turn lights a 250-watt tungsten lamp, so located in the boiler room that the attention of all of the firemen is drawn to it in case one or more chimneys are smoking for an extended period, owing to the fireman neglecting his fires. When this lamp burns, each fireman must satisfy himself that his fire is not causing the

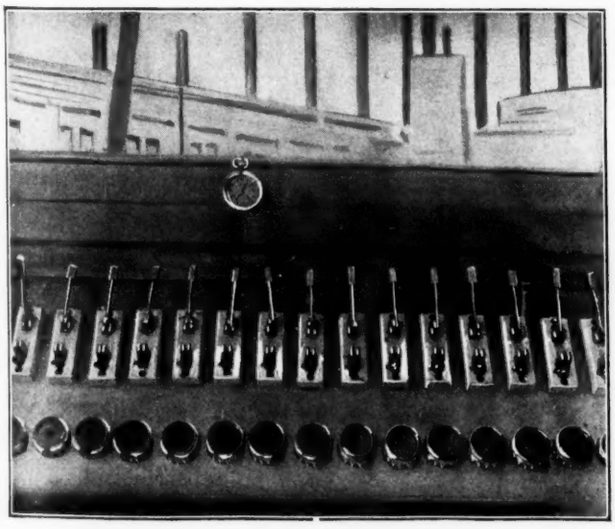


FIG. 1. SWITCHBOARD IN OBSERVATION HOUSE

smoke by observing whether his red light is on or not. When the observer throws in a switch, a pilot light on the switchboard, Fig. 1, connected in parallel with the red light in the boiler room, is illuminated, thus showing conclusively that the corresponding lamp in the boiler house is also in circuit. Throwing out the switch cuts out both lights.

Attached to the wall at one end of the observation house there are four time-recording gages, Fig. 2, each making five records on a single chart. When a switch is thrown in, the corresponding pen arm of the recorder begins marking on the chart and continues to do so during the period the switch is in, thus giving the time the switch was thrown in and the period the circuit was closed. When the switch is cut out, that

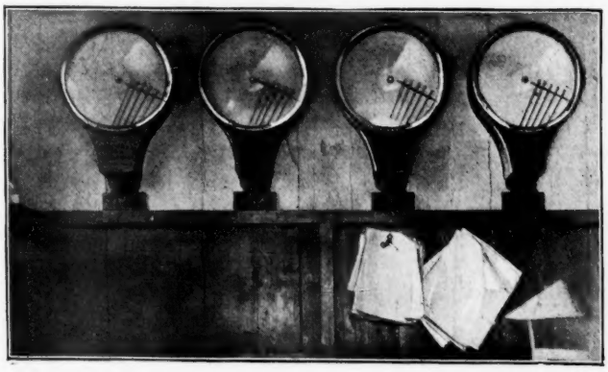


FIG. 2. RECORDING GAGE GIVES RECORD OF SMOKING CHIMNEYS

particular record ceases until the switch is again thrown in to close the circuit.

All the recorders were designed for direct current, but they are used with 12-volt alternating current in this instance. The instrument, when used with alternating current, produces a tremulous line on the chart. This has been overcome by submerging the pen-actuating mechanism in oil that is held in a small metal box open at the top and secured to the back of the instrument. The oil acts as a dashpot and prevents the pens from vibrating. No other mechanical changes were made in the instruments and their front appearance is the same as before the alteration.

An observer while on watch devotes his entire attention to the smoke condition of the chimneys. On a

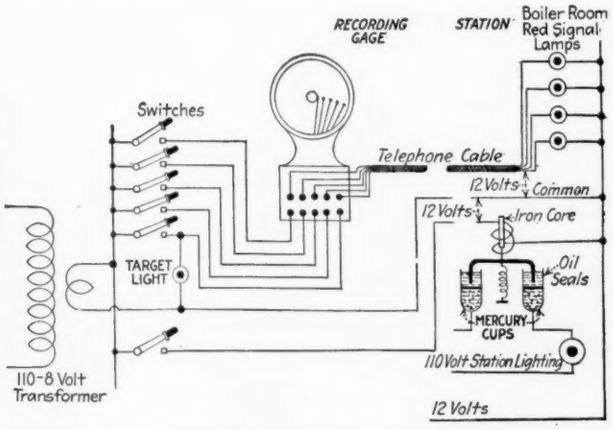


FIG. 3. DIAGRAM OF WIRING AND OUTLINE OF THE RELAY

board posted in the yard in front of the observation station is a Ringelmann smoke chart showing Nos. 1, 2, 3 and 4 smoke screens. As soon as smoke corresponding in color to No. 2 chart appears from a chimney, the switch for that particular fireman is thrown in and kept in until the smoke is reduced in color to correspond to No. 1 chart when the operator throws out the switch controlling the lights on that particular boiler. Gongs

and whistles are used in the boiler rooms to attract the firemen in case no attention is paid to the lights. A diagram of the wiring is shown in Fig. 3, together with a sketch of the relay. All this apparatus, including the step-down transformer, relay and switchboard, was made at the plant.

In a nutshell, the operation of a system is as follows: The operator observes that No. 3 stack is making smoke corresponding to No. 2 chart. The switch of No. 3 circuit is thrown, which lights the lamp in front of the fireman who is operating the boilers served by No. 3 stack; also lighting the lamp at the switch, and bringing the No. 3 recording pen of the time recorder into action. The fireman immediately makes such changes in the stoker adjustment as are necessary to correct the condition. Both the combustion engineer and the water tender are available to assist him if needed. When the smoke has been reduced to correspond to No. 1 chart, the switch is opened, thus cutting out the lights, and allowing the pen of the time recorder to drop back to zero. The same routine applies to all cases.

The adoption of this system eliminates any chance on the part of the observer of recording erroneous entries on a log sheet, as might easily occur if the log system *only*, were used. Complete daily and weekly reports are made, which show by comparative analysis which fireman is responsible if any smoke is made. Recording instruments keep an accurate record, and leave no room for dispute on the part of the fireman as to the duration of the smoke of a chimney. These charts are changed daily, and filed for future reference.

This system was devised and put into service by the engineer at the plant.

The Granby Power Plant at Anyox, B. C.*

By WAKELY A. WILLIAMS†

Hydro-electric power for the Granby mines and plant is obtained at the mouth of Falls Creek. A dam, 110 ft. high, was built one mile upstream, and water is conducted to the power house through a 6-ft. wood-stave pipe giving an effective head of 357 ft. The power house is equipped with waterwheels direct-connected to compressors, converter blowers and electric generators. An auxiliary 6000-hp. steam plant provides power during the winter season when there is a diminished water supply.

THE mines, smeltery and hydro-electric power plant of the Granby Consolidated Mining, Smelting and Power Co., at Anyox, B. C., are situated on the west shore of Observatory Inlet, an arm of the sea in northwest British Columbia. Power for the various operations of the company is secured from a hydro-electric plant which utilizes the water from Falls Creek, and from a 6000-hp. steam plant which operates during the winter months when there is a decreased water supply.

Falls Creek, a stream of considerable size emptying into Granby Bay at the north end of the smeltery site, receives its flow from melting glaciers. The surrounding hills are steep and provide but little chance for storage. The company constructed a crib and rock-fill dam 110 ft. high at a suitable point a mile distant, where the canyon is narrow and the stream could be deflected over a natural rock spillway 125 ft. wide. From this dam the water is taken by a 6-ft. wood-stave pipe down the creek and across the north end of the smeltery site to the power house. From the smelting plant to the power house, the penstocks are of steel with branches leading to the various waterwheels. The arrangement and location of the pipe line gives a water pressure of 110 lb. at the smeltery site. The head of water on the waterwheel nozzles at the power house is 375 ft., the effective head giving a pressure of about 165 pounds.

The power house is a brick-and-steel structure, and all foundations are on solid rock. A 15-ton crane running the length of the building handles the heavy machinery. The discharge from the waterwheels is a little above the high-tide mark on Falls Creek. The building is 50 ft. wide by 180 ft. long and has concrete floors. In this building are installed the following: One variable-capacity waterwheel-driven two-stage air compressor, with cylinders 22 and 36 x 42 in., running at 84 r.p.m., with a capacity of 4000 cu.ft. of free air per minute delivered at 100-lb. pressure; one waterwheel-driven special converter blowing engine with duplex cylinders, 60 and 60 x 48 in., running at 75 r.p.m. and giving a capacity of 20,500 cu.ft. of free air per minute delivered at 16-lb. pressure; three high-pressure blast-furnace blowers, having a displacement of 400 cu.ft. of free air per revolution and each with a capacity of 45,000 cu.ft. of free air per minute at 48-oz. pressure. The wheel buckets are directly bolted to specially designed flywheels. The blowers are connected by chain drive to 500-hp. motors, and can be driven either by water or by electric power. A pipe system leads to the furnaces and converters from the blowers, and high-pressure air is delivered to the mine by 9-in. and 6-in. pipe lines. Two direct-connected motor-driven pumps take water from the raceways and deliver it to condensers at the steam plant.

The present hydro-electric plant consists of two 938-kv.-a. alternators, with two 700-hp. overhung waterwheels to each alternator. Alternating current at 2200 volts is generated by 60-cycle three-phase alternators. They are separately excited by two 50-kw. motor-generator sets, one of which has an overhung waterwheel on an extension motor shaft for initial starting. The excitation voltage is 125 volts. The 6-ft. pipe line from the dam branches to 25-in. pipes outside the power house for delivery to each wheel. The effective head used is 372 ft. The 25-in. lines divide again at a Y near the waterwheels into two 18-in. pipes, one of which leads to each wheel. The waterwheel driving the exciter is fed by an 8-in. pipe.

*Abstracted from "Engineering and Mining Journal."

†Superintendent of smelters, Granby Consolidated Mining, Smelting and Power Co., Anyox, B. C.

There are two 300-kw. motor-generator sets, supplying direct current at 550 volts, for railroad and smeltery use. The generators are each driven by a 440-hp. 2000-volt three-phase 60-cycle induction motor.

The switchboard is divided into 15 panels. A synchronoscope is mounted on a bracket together with two voltmeters, one for each machine, and below these there is a voltage regulator. Two panels are devoted to generator control, and the remaining ones are used for controlling the exciter units, station lighting motor-generator sets, mine and smeltery power feeders, smeltery, town and power circuits, railroad feeders, cranes and a totalizing panel. The mine is supplied by one three-phase line direct to the line substation and a branch three-phase line from the town circuit for emergency use. All the cables between the boards and the machines are rubber-covered and braided. Stranded 2200-volt three-conductor and single-conductor cables are laid in fiber conduits.

All the power supplied to the mines goes to the mine substation where there is a five-panel switchboard connecting incoming and outgoing power lines. The outgoing lines are on No. 2 panel, which has one three-phase 2200-volt power line for motors. No. 3 panel has two single-phase lines for small motors and heating and lighting around the plant. The fourth panel controls the motor for the motor-generator set which supplies 500-volt direct-current for ore haulage. The fifth panel controls the direct-current generator.

On account of the glacier feed to Falls Creek, there is a period of three months in the winter of extreme cold, when the flow of water is not enough to give all the power needed to fully operate mines and smelter to capacity. To be insured against this shortage of power there has been installed an auxiliary steam plant of 6000 hp. For this purpose a reinforced-concrete building has been erected across the creek opposite and facing No. 1 power house, with dividing walls separating the boiler and operating rooms. In the boiler room there are five 550-hp., oil-fired water-tube boilers with superheaters. All the necessary machinery is installed to make them easily and cheaply operated.

In the operating room there are installed: One 3750-kv.-a. three-phase 60-cycle 2200-volt turbo-generator; one 2000-kv.-a. three-phase 60-cycle 220-volt turbo-generator; one exciter; and one turbo-compressor with 800-hp. motor so arranged that it can be driven either by steam turbine or motor. The capacity is 3500 cu.ft. of free air per min. at 100-lb. pressure. There is a space allowance for one extra turbo-generator. All the necessary condensers, vacuum pumps, switchboards, etc., are installed to make an up-to-date and efficient plant.

The warehouse building is of wood 36 ft. wide and 160 ft. long. A complete stock of supplies and repair parts is kept on hand, larger than would be the case if the works were not so removed from the source of supply.

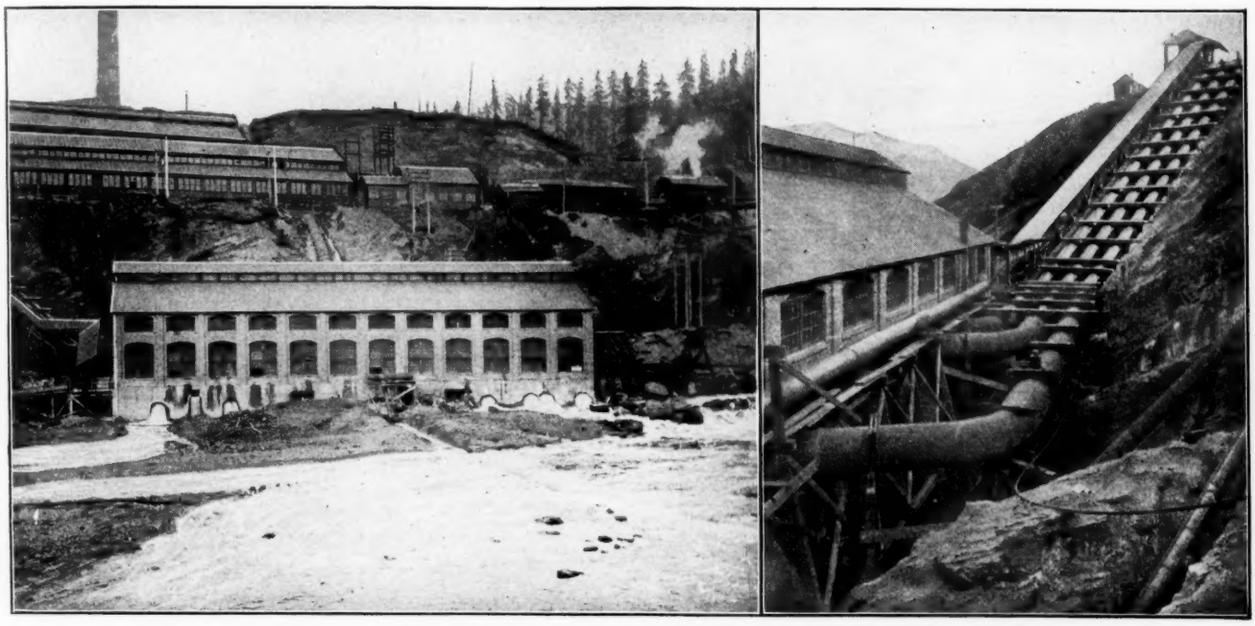


FIG. 1. HYDRO-ELECTRIC POWER PLANT OF THE GRANBY COMPANY AT ANYOX, B. C.
To the left is shown the plant with a portion of the smelting works in the background. On the right are shown the air mains leading from the hydro-electric plant to the smeltery

The two power houses face each other on opposite banks of Falls Creek, which is about 300 ft. wide at this point. Close to each power house a wooden four-pole structure is erected and the cables span the creek about 30 ft. above high water.

In No. 1 power house three 500-hp. 2000-volt three-phase 60-cycle motors drive the blowers. Enough resistance is installed in the secondary circuit of each motor to obtain speed variation for continuous duty from half to full speed.

For additional 16-lb. air, there is being installed one 25,000-cu.ft. turbo-blower, driven by an 1800-hp. three-phase 60-cycle 2000-volt motor. The control is mounted on one panel and on the panel is one overload circuit-breaker and three interlocking starting switches connecting the motor through the 2000-kv.-a. auto-transformer, one ammeter and one watt-hour meter. To obtain additional power for the railroad, a new 500-kw. synchronous motor-generator set is being installed to run in parallel with the one at present in operation.

The motor of this set will also be used for power-factor correction, and arrangements are made for future waterwheel connections on the extension of the motor shaft.

The cables from No. 2 power house are brought to a panel in No. 1 power house, on which is mounted a circuit-breaker, voltmeter, synchronizing plug and watt-hour meter.

The power line to the mine will be overloaded when these extensions are complete, and to remedy this the line potential will be raised to 6600 volts using a step-up bank of three 150-kv.-a. 2200 to 6600 volts at power house No. 1, and three 150-kv.-a. 6600 to 2200 volts at the mine substation. The distribution control of the whole equipment is kept at No. 1 power house.

The electrical energy generated by these power stations is utilized for various purposes. The electric locomotives for ore-haulage use power from a 100-kw. motor-generator set installed in the substation or else power is taken from the railroad-trolley feeders which receive power from power house No. 1. At present one 6-ton locomotive operates on the 530-ft. level of the mine on a 2-ft. gage track, hauling ore to the main pockets and hauling out waste. At the 385-ft. or main shipping level, three 6-ton locomotives are in service, hauling ore from the pockets to the bins, a distance of three-quarters of a mile. At the bins there are two crushers, each belt-driven by a 150-hp. 2200-volt three-phase motor. On the 150-ft. level of the mine a 6-ton locomotive is used for hauling waste from development work. The railroad runs into the mine tunnel at the 150-ft. level where eight and ten 25-ton cars are made up into trains for one of the 42-ton electric locomotives to haul to the smeltery storage bins. The 42-ton locomotives are also employed to convey ore, coke, etc., from the dock to the smeltery bins. These locomotives are provided with four 84-hp. 500-volt mine motors, double-end series-parallel control with independent automatic air for breaking. When operating in series two motors, one for each truck, are in series, and parallel operation gives full line voltage to each motor.

The furnace-charge trains are hauled by three 12-ton mine locomotives and each locomotive has two 500-volt direct-current series interpole motors.

There are about six miles of track including yards, all equipped with trolley 18 ft. over the center of the track. A 0000 copper feeder is carried on cedar poles.

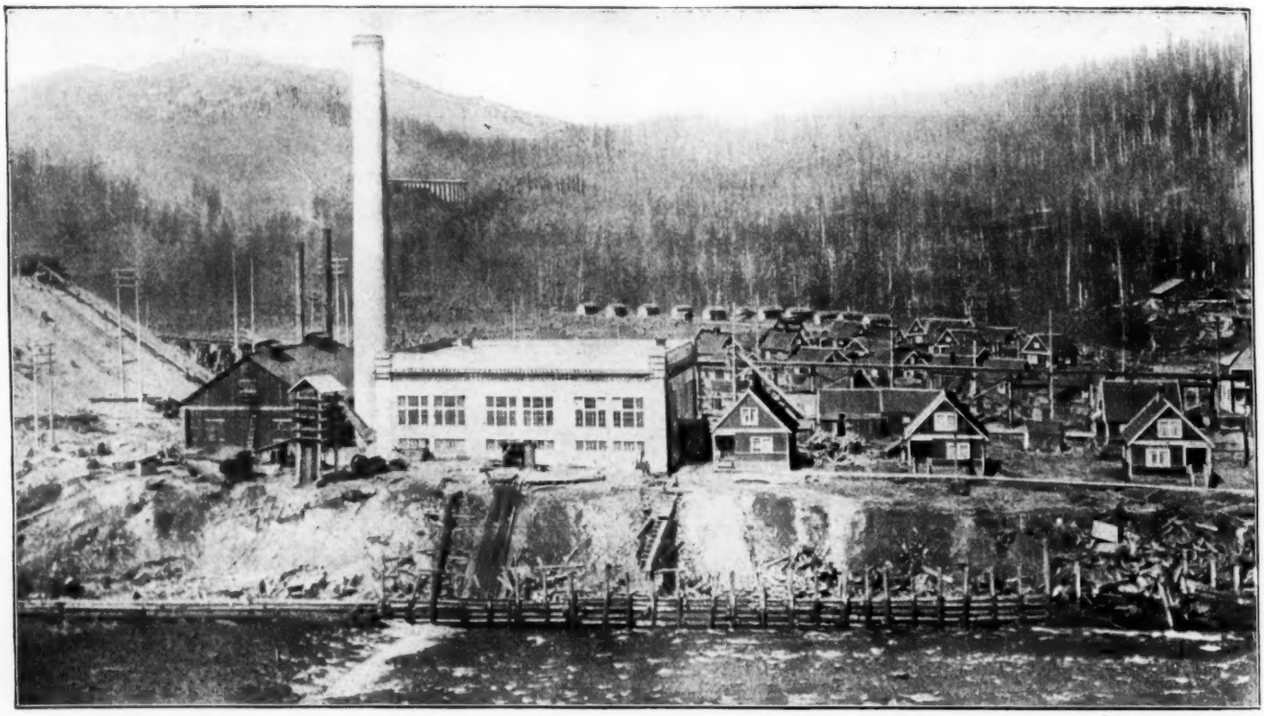


FIG. 2. THE GRANBY COMPANY'S 6000-HP. STEAM PLANT—FOREGROUND IS FALLS CREEK, WHICH FURNISHES POWER FOR THE HYDRO-ELECTRIC PLANT

Motor drive is used at the smeltery and for driving various machines in the machine, electrical and other shops connected with the mine.

"Thumbnail Facts" About Centrifugal Pumps—In centrifugal pumps the capacity, head and power required, bear the following relation to one another:

Capacity varies as the first power of the speed.

Head varies as the second power of the speed.

Power varies as the third power of the speed.

To aid the memory, observe that capacity (*C* the first in the alphabetical order) comes first and is the first power; head (*H*) likewise is the second in order and is the second power; and power (*P*) is third and is the third power of the speed.

Conservation friends and American legislators may be interested to know that an English company organized by Dr. F. S. Pearson has practically completed water-power projects for supplying the Barcelona (Spain) district, aggregating 470,000 hp. America has quite a bit of water power yet undeveloped that would be a national asset if developed.

Reconnecting Induction Motors—For Change of Voltage with Change of Phase

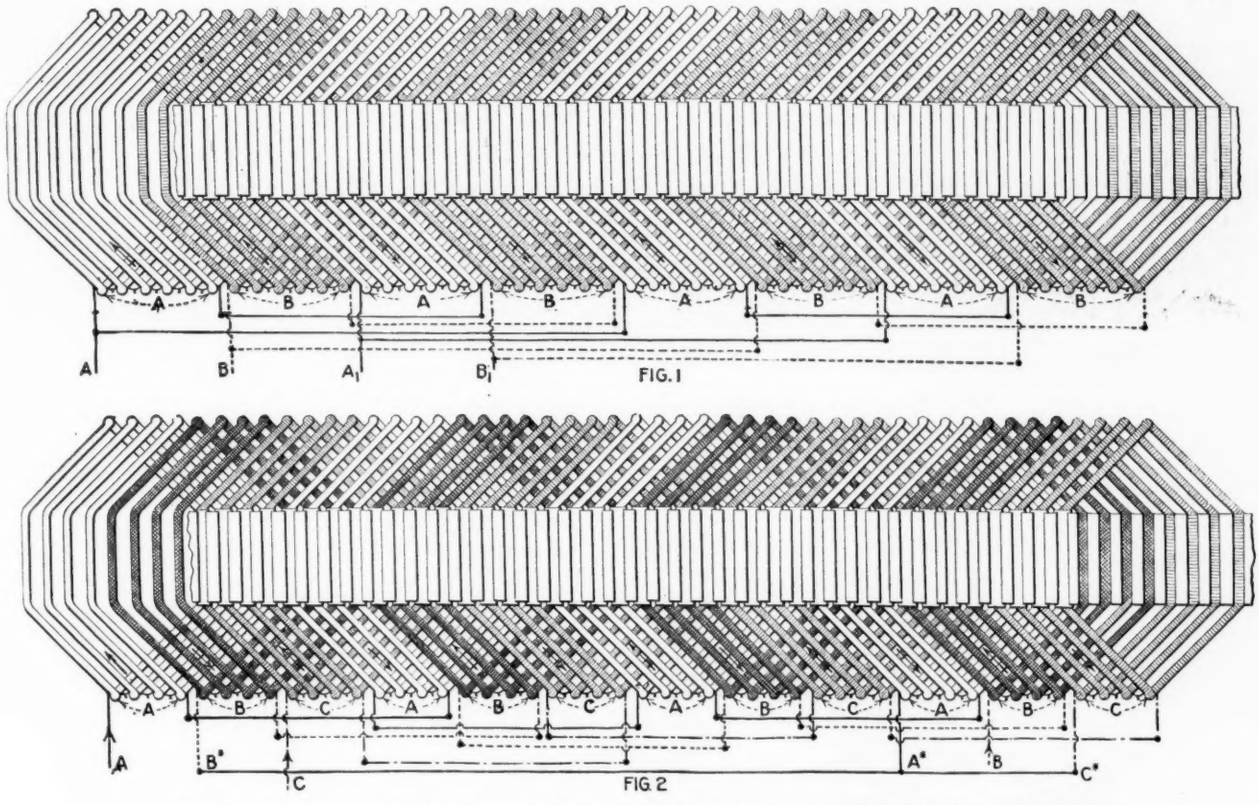
By A. M. DUDLEY
Designing engineer, Westinghouse Electric and Manufacturing Co.

The various winding connections that may be employed, to change an induction motor so that it will operate on a voltage and phase different from that for which it was designed, are discussed. A table is given whereby the changes to be made can be readily determined. Examples are worked out showing how to apply the tables in solving practical problems.

IT OFTEN happens that in changing the winding of a motor to accommodate a change in the number of phases, it is necessary to arrange for a change in the operating voltage at the same time; as for example, changing a three-phase 440-volt winding to operate on two-phase 220 volts. In an earlier article (Nov. 13 issue) reference was made to the fact that on a given winding the normal three-phase voltage would be 125 per cent. of the normal two-phase voltage. Expressing the same condition in another way, if two motors that are otherwise identical are made to operate on the same voltage except that one is two-phase and the other is three-phase, the three-phase winding will have only about 80 per cent. of the number of turns in series that are necessary in the two-phase winding. The foregoing is on the assumption that the three-phase winding is star-connected, which is usually the case. This fact permits one very convenient reconnection of this nature; namely, the one where a two-phase 440-volt winding is to be reconnected for three-phase 550 volts or vice versa.

Since 440 is 80 per cent. of 550, the number of turns in series is exactly right for either the two-phase or the three-phase combination, and the only thing that has to be done is to regroup the coils for the proper number of pole-phase groups, which in a three-phase motor is 50 per cent. greater than in a two-phase, and to shift the so-called "phase coils" or coils with heavier insulation to their proper positions at the beginning and end of each pole-phase group. Other combinations of changes of phase and voltage are met with, and it is useful to make up a table similar to the one accompanying this article, which indicates at a glance the possible changes between two- and three-phase, star and delta, series, 2, 3, 4, 5 and 6 parallels.

This table is a combination of the two given in the article (Sept. 11 issue) under voltage changes and shows the combination of phases as well. The manner of using this table has been explained under voltage



FIGS. 1 AND 2. TWO- AND THREE-PHASE, FOUR-POLE INDUCTION-MOTOR WINDINGS

Fig. 1—Four-pole, two-phase, two-parallel-connected winding. If Fig. 1 is correct for two-phase, 220 volts, Fig. 2 is suitable for three-phase, 550 volts

Fig. 2—Four-pole, three-phase, series-star-connected winding.

changes, but further examples will be given here showing the way to apply it, since it gives a ready answer to practically any questions that may be asked regarding the possibility of changing windings when a change of voltage or phase or a combination of the two is involved. It will be noticed that the table as arranged is really given in percentages. That is to say, the original connection on the motor is called 100 or assumed to be good for a normal voltage of 100, and then if the winding is assumed as reconnected in some other way, the normal voltage on which the reconnected motor should be operated is shown at the intersection of the horizontal and vertical columns.

Take, for example, a motor which was originally connected three-phase 2 parallel delta. Following across this horizontal line, the number 100 is found under the vertical heading that also reads "three-phase 2 parallel delta," or, in other words, when a motor is normally connected for three-phase 2 parallel delta and is operated as three-phase 2 parallel delta, it is being operated at 100 per cent., or exactly as the designer intended it should be operated. Suppose, however, that the winding is reconnected two-phase series, the question at once arises upon what voltage the motor should be operated to give normal operation. Following the same horizontal column, "three-phase 2 parallel delta" (since that is the original connection) across until it intersects the vertical column marked "two-phase series," the number 280 appears at the intersection of the two columns. In others words, if the three-phase 2 parallel delta-connected winding is regrouped and reconnected two-phase series it must be operated on a voltage 280 per cent. of the original voltage for which it was designed.

The reason these values are given in percentages instead of actual voltages is to make the table more flexible and of wider application. The percentages, however, can be very simply changed to voltages by using them as a multiplier. Applying this to the case just used as an example, assume that the voltage on which the original motor operated was 220. This then represents the 100 per cent. which was called "three-phase 2 parallel delta." When changed to two-phase series, it has been shown that a voltage of 280 per cent. would be required. From this it follows at once that the new operating voltage for the motor when reconnected two-phase series must be 280 per cent. of 220 volts, or $2.8 \times 220 = 616$ volts.

As another example of applying the table take a case where a four-pole motor connected two-phase 2 parallels, as in Fig. 1, and operated on 220 volts is to be changed, if possible, for operation on a three-phase 550-volt circuit and it is desired to know what particular kind of a three-phase connection on the winding will give normal operation when the motor is run on 550 volts. In this case the horizontal line two-phase 2 parallels represents 100 per cent. If the original voltage was 220 and that was 100 per cent., the new voltage 550 must be 250 per cent., since it is 2.5 times 220. To find the proper form of three-phase connection, follow the horizontal column "two-phase 2 parallels" (since that was the original connection) across until it shows the value 250 under some vertical column which is headed "three-phase." This is seen to be the first vertical column, marked "three-phase series star." From this the conclusion is at once correctly drawn that if a motor is connected two-phase 2 parallels and

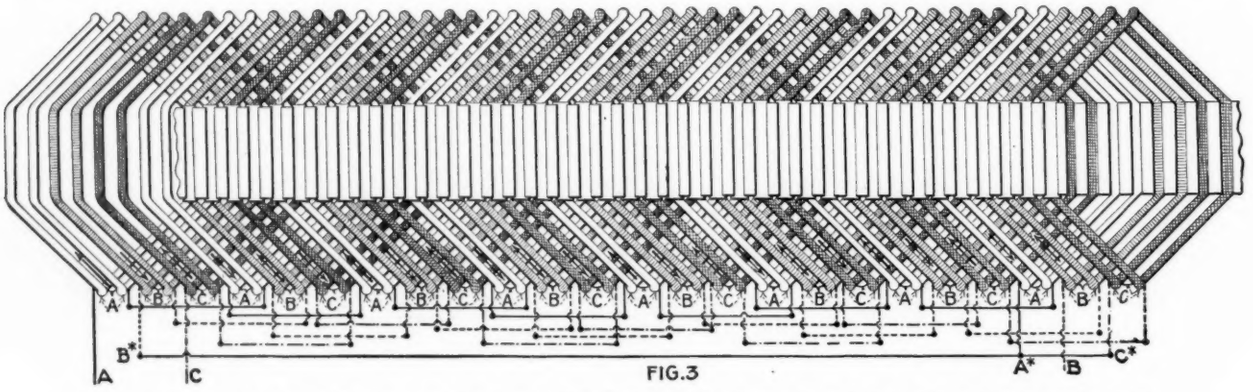


FIG. 3

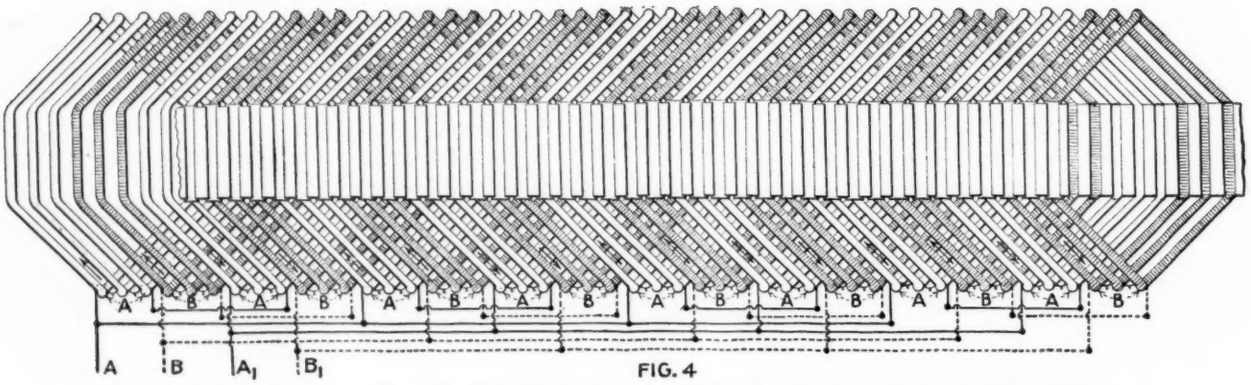


FIG. 4

FIGS. 3 AND 4. TWO- AND THREE-PHASE, EIGHT-POLE INDUCTION-MOTOR WINDINGS

Fig. 3—Eight-pole, three-phase, series-star-connected winding. Fig. 4—Eight-pole, two-phase, four-parallel-connected winding. If Fig. 3 will operate on 2200 volts, three-phase, Fig. 4 is correct for 440 volts, two-phase

run on 220 volts and it is reconnected to three-phase series star, it will be suitable for operating normally on a three-phase 550-volt circuit. It is assumed, of course, in this problem that the number of poles and

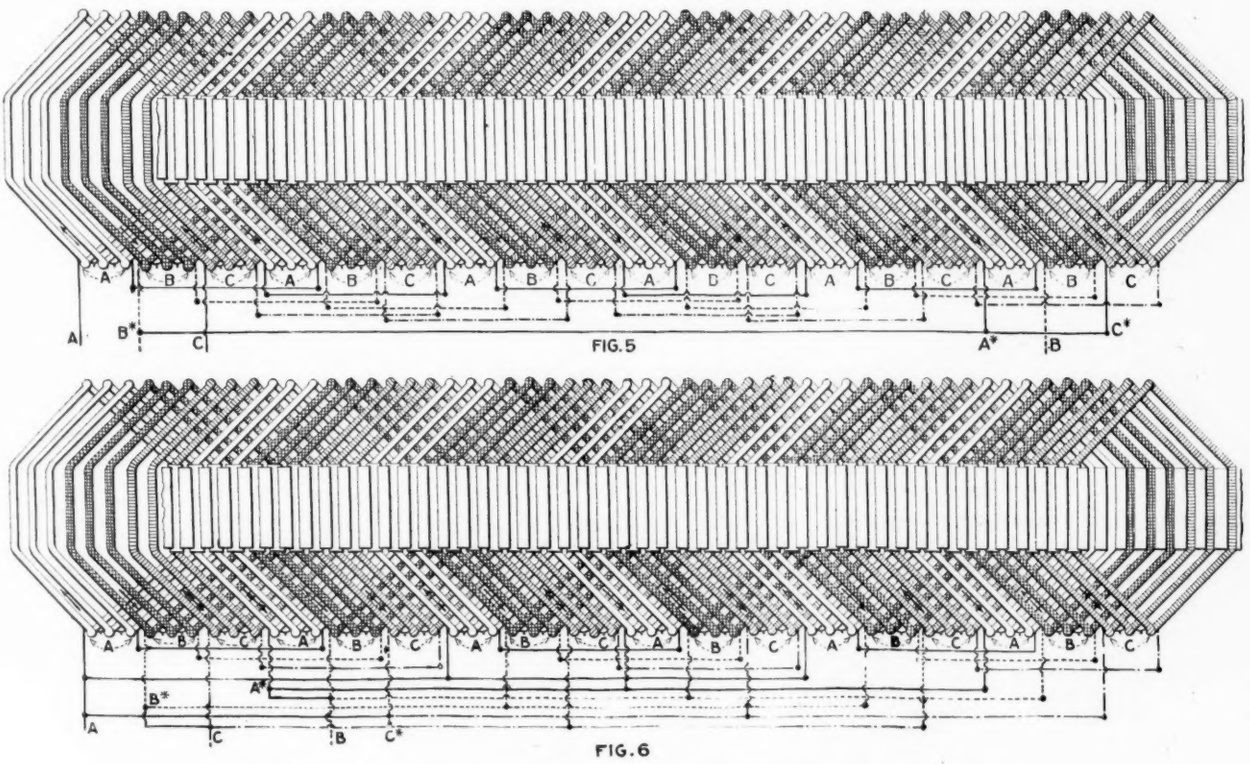
COMPARISON OF MOTOR VOLTAGES WITH VARIOUS CONNECTIONS AND PHASES

If a motor connected originally as shown in any horizontal column had a normal voltage of 100, its voltage when reconnected, as indicated in any vertical column is shown at the intersection of these two columns.

Form of Connection	Three-Phase Series Star	Three-Phase 2 Parallel Star	Three-Phase 3 Parallel Star	Three-Phase 4 Parallel Star	Three-Phase 5 Parallel Star	Three-Phase 6 Parallel Star	Three-Phase Series Delta	Three-Phase 2 Parallel Delta	Three-Phase 3 Parallel Delta	Three-Phase 4 Parallel Delta	Three-Phase 5 Parallel Delta	Three-Phase 6 Parallel Delta	Two-Phase Series	Two-Phase 2 Parallels	Two-Phase 3 Parallels	Two-Phase 4 Parallels	Two-Phase 5 Parallels	Two-Phase 6 Parallels
Three-phase Series Star	100	50	33	25	20	17	58	29	19	15	12	10	81	41	27	20	16	14
Three-phase 2 Parallel Star	200	100	67	50	40	33	116	58	39	29	23	19	162	81	54	40	32	27
Three-phase 3 Parallel Star	300	150	100	75	60	50	173	87	58	43	35	29	243	122	81	60	48	41
Three-phase 4 Parallel Star	400	200	133	100	80	67	232	116	77	58	46	39	324	163	108	80	64	54
Three-phase 5 Parallel Star	500	250	167	125	100	83	289	144	96	72	58	48	405	203	135	100	80	68
Three-phase 6 Parallel Star	600	300	200	150	120	100	346	173	115	87	69	58	486	243	162	120	96	81
Three-phase Series Delta	173	86	58	43	35	29	100	50	33	25	20	17	140	70	47	35	28	23
Three-phase 2 Parallel Delta	346	173	115	87	69	58	200	100	67	50	40	33	280	140	94	70	56	47
Three-phase 3 Parallel Delta	519	259	173	130	104	87	300	150	100	75	60	50	420	210	141	105	84	70
Three-phase 4 Parallel Delta	692	346	231	173	138	115	400	200	133	100	80	67	560	280	188	140	112	93
Three-phase 5 Parallel Delta	865	433	288	216	173	144	500	250	167	125	100	83	700	350	233	175	140	117
Three-phase 6 Parallel Delta	1,038	519	346	260	208	173	600	300	200	150	120	100	840	420	280	210	168	140
Two-phase Series	125	63	42	31	25	21	72	37	24	18	15	12	100	50	33	25	20	17
Two-phase 2 Parallels	250	125	84	63	50	42	144	73	49	37	29	24	200	100	67	50	40	33
Two-phase 3 Parallels	375	188	125	94	75	63	216	111	73	55	44	37	300	150	100	75	60	50
Two-phase 4 Parallels	500	250	167	125	100	84	288	148	97	73	58	49	400	200	133	100	80	67
Two-phase 5 Parallels	625	313	208	156	125	105	360	165	122	91	73	61	500	250	167	125	100	84
Two-phase 6 Parallels	750	375	250	188	150	125	433	217	144	108	87	72	600	300	200	150	120	100

the frequency and horsepower remain the same on the new circuit as on the old, the only difference being that the old circuit was two-phase 220 volts and the new circuit three-phase 550 volts. The changed connection is shown in Fig. 2.

To further illustrate the use of the table, assume that an eight-pole motor is connected series star, as in Fig. 3, and operated on a three-phase 2200-volt circuit, what form of reconnection would make it suitable for operation on a two-phase 440-volt circuit? In this case "series star" is 100 per cent. in the horizontal column and 100 per cent. equals 2200 volts. The desired voltage is 440, which equals $\frac{1}{5}$ or 20 per cent. of 2200. Following the "three-phase series star" horizontal column across to the value 20, it is found first under "three-phase 5 parallels," but this is discarded since a two-phase connection is wanted; furthermore, an eight-pole winding cannot be connected in 5 parallels. The value 20 is seen the second time under the vertical column marked "two phase, 4 parallels." If the number of poles is divisible by 4, as in this case, the winding can be put in 4 parallels, therefore the conclusion is reached that this is the desired connection, or in other words, if a three-phase motor is connected series-star and operated on 2200 volts and is reconnected to two-phase 4 parallels, it will be suitable for operation on 440 volts. This



FIGS. 5 AND 6. THREE-PHASE, SIX-POLE INDUCTION-MOTOR WINDINGS

Fig. 5—Six-pole, three-phase, series-star-connected winding. Fig. 6—Six-pole, three-phase, three-parallel delta-connected winding. If Fig. 5 is right for 2200 volts, three-phase, Fig. 6 will operate on 440 volts, three-phase

connection is shown in Fig. 4. Again, assume that the motor has only six poles, as in Fig. 5, and it is to be changed from three-phase 2200 volts to three-phase 440 volts. In this case 2200 volts is again 100 per cent. and 440 volts is 20 per cent. Following the horizontal column marked "three-phase series star," the value 20 is first found under "three-phase 5 parallel star," meaning that if the winding could be put in 5 parallels it would be good for 440 volts, since $\frac{2200}{5} = 440$. However, a six-pole winding cannot be connected in 5 parallels and the horizontal column is followed farther. There is not another 20 under the three-phase vertical columns, but there is a 19, which is nearly right, under "three-phase 3 parallel delta." Since a six-pole winding can be arranged in 3 parallel delta, as in Fig. 6, this is the connection desired, and the normal operating voltage will be 19 per cent. of 2200 = 418, which is near enough to operate satisfactorily on a 440-volt circuit.

From these scattered examples it can be seen that the table is of wide application and answers two types of questions. The first of these is what will be the new operating normal voltage if a winding is reconnected in a certain way, and the second is, what will be the form of the connection to get a new operating voltage which is desired. Indirectly, the table answers the question of whether it is at all possible to get the desired combination of changes without new coils, and if not exactly possible, what degree of approximation may be obtained by means of the working combination utilized.

In the case of wound-rotor machines it may be noted that changing either the phase or voltage of the stator has no effect on the rotor winding as long as the table shows that the reconnection gives exactly the right conditions. The reason for this is that the real magnetic rotating field is neither two-phase nor three-phase, but is just the same as if set up by direct current. This was described in the first article of this series. Since this rotating field remains at the same value before and after the reconnection, it will clearly have the same effect on the rotor winding in generating counter-electromotive force. Hence there will be the same voltage between collector rings as existed with the original connection, and there need be no change in the controller or the external resistance used in starting and running the motor.

An Easy Way of Figuring Radiation

By K. TOENSFELDT

Charts giving direct radiation required from room measurements. Brick walls 13, 18 and 22 in. thick and of the usual construction are covered. There are wall, glass and air-leakage charts, the sum of the readings from the three giving the total radiation.

ONE who knows the tediousness of calculating the heat losses from buildings will welcome almost any relief in the form of charts or tables that will facilitate the computations. The writer has prepared a set of charts which involve a simplification that has not appeared to his knowledge in other charts. This simplification consists of considering a wall area, including all window areas, as wall, and calculating the total heat loss for the wall. The window area has then been considered as wall exposure and each square foot of window area has been multiplied by the unit heat loss, *Kw*, for the wall. To this the remaining loss per square foot by which the window exceeds the wall must be added.

If the unit heat loss for the glass is *Kg*, then the excess of the unit heat loss for the window over that for the wall is $Kg - Kw$. By multiplying the wall area, including the window area by *Kw*, and adding to this the window area multiplied by $Kg - Kw$, the total heat loss due to wall and window areas is fully determined without the usual involved subtractions.

The accompanying Charts 1 to 6 are constructed on this premise and show the heat losses and radiation required for 13-, 18- and 22-in. brick walls, the constants assumed being shown in the accompanying table. The constant used for glass equals 1 B.t.u. per square foot per hour for 1 deg. rise in temperature.

Due to the method just outlined, each chart for a certain thickness of wall has its accompanying glass chart; that is, with the chart for a 13-in. wall must be used the chart for glass in a 13-in. wall. To use the charts proceed as follows:

Referring to Charts 1, 3 and 5, locate at the top of the chart the lineal feet of wall. If it is a north or west wall subject to exposure, locate the length of the wall on the upper scale, which allows for 10 per cent. increase for exposure. From this reading drop down to the ceiling height and opposite this point find on the left-hand scales: (1) The heat loss for one degree temperature difference per hour; (2) the direct radiation required for a maximum of 70 deg. temperature difference between the inside and outside temperatures; (3) the direct radiation required for a maximum of 80 deg. temperature difference between the inside and outside temperatures. Charts 2, 4 and 6 are obviously used in the same manner as 1, 3 and 5, the difference being that they apply to window areas.

The cubic contents are so easily found on the slide rule that Chart 7 was plotted for the cubic contents on one scale, and the same resultant heat loss and required radiation of the previous charts on the other scale.

For example: Given a 13-in. wall, southern exposure, 24 ft. long and 10 ft. high, with three windows 3½ x 6½ ft., find the radiation necessary for zero outside and 70 deg. inside temperature.

Referring to Chart 1, 24 lin.ft. of 13-in. wall with a 10-ft. ceiling height would require 21 sq.ft. of direct radiation for a 70-deg. temperature difference. Referring to Chart 2, three windows 3½ ft. wide have 10½ lin.ft. of glass in a 13-in. wall, and with a 6½-ft. window height would require 13 sq.ft. of direct radiation for a 70-deg temperature difference. Then the total direct radiation required is 21 + 13 = 34 square feet.

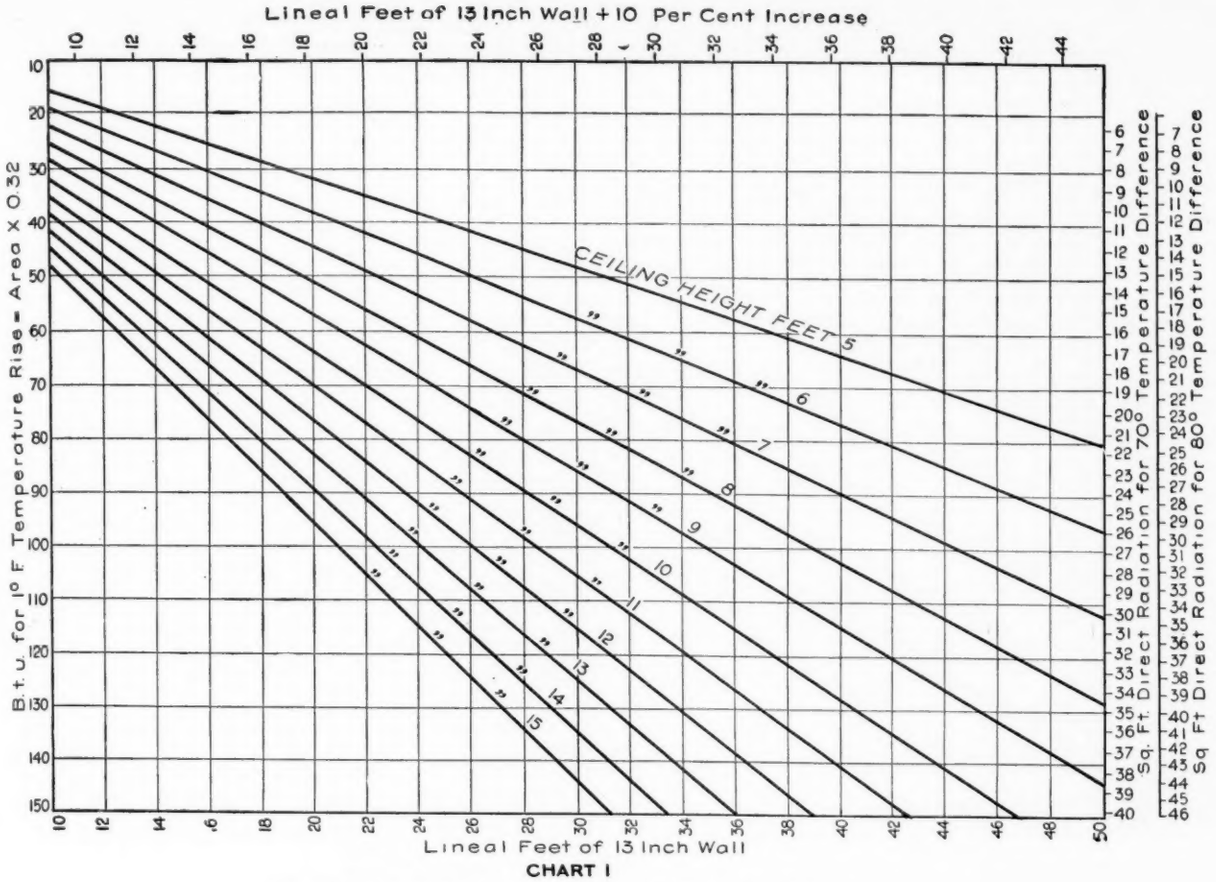

Lineal Feet of 13 Inch Wall + 10 Per Cent Increase
B.t.u. for 1° F Temperature Rise = Area X 0.32
CEILING HEIGHT FEET 5
" 6
" 7
" 8
" 9
" 10
" 11
" 12
" 13
" 14
" 15
Sq. Ft. Direct Radiation for 70° Temperature Difference
Sq. Ft Direct Radiation for 80° Temperature Difference
Lineal Feet of 13 Inch Wall

CHART 1

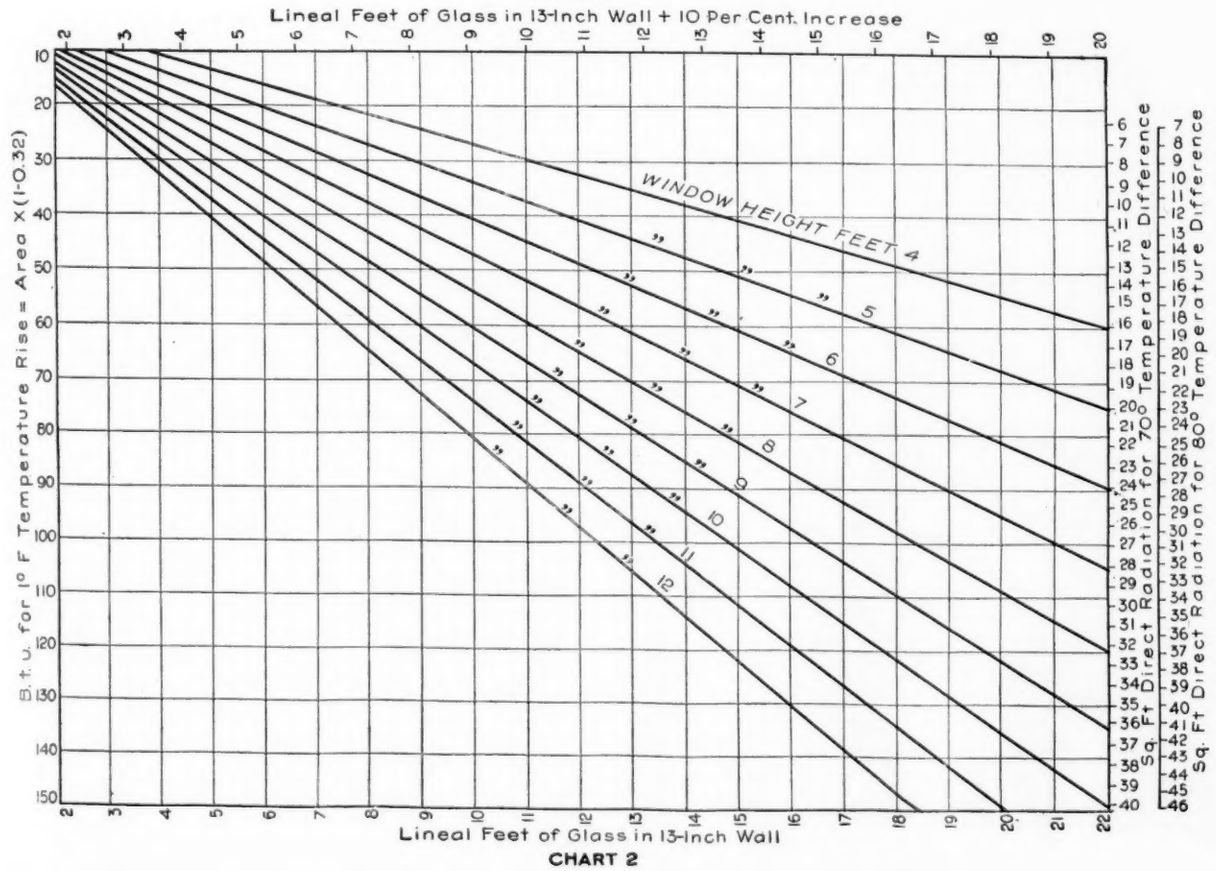

Lineal Feet of Glass in 13-Inch Wall + 10 Per Cent. Increase
B.t.u. for 1° F Temperature Rise = Area X (1-0.32)
WINDOW HEIGHT FEET 4
" 5
" 6
" 7
" 8
" 9
" 10
" 11
" 12
Sq. Ft. Direct Radiation for 70° Temperature Difference
Sq. Ft Direct Radiation for 80° Temperature Difference
Lineal Feet of Glass in 13-Inch Wall

CHART 2

TOTAL RADIATION FOR 13-IN. WALL IS THE SUM FOUND BY CHARTS 1, 2 AND 7

Chart 1—Square feet radiation per square foot exposed 13-in. wall. Chart 2—Square feet radiation per square foot of glass surface

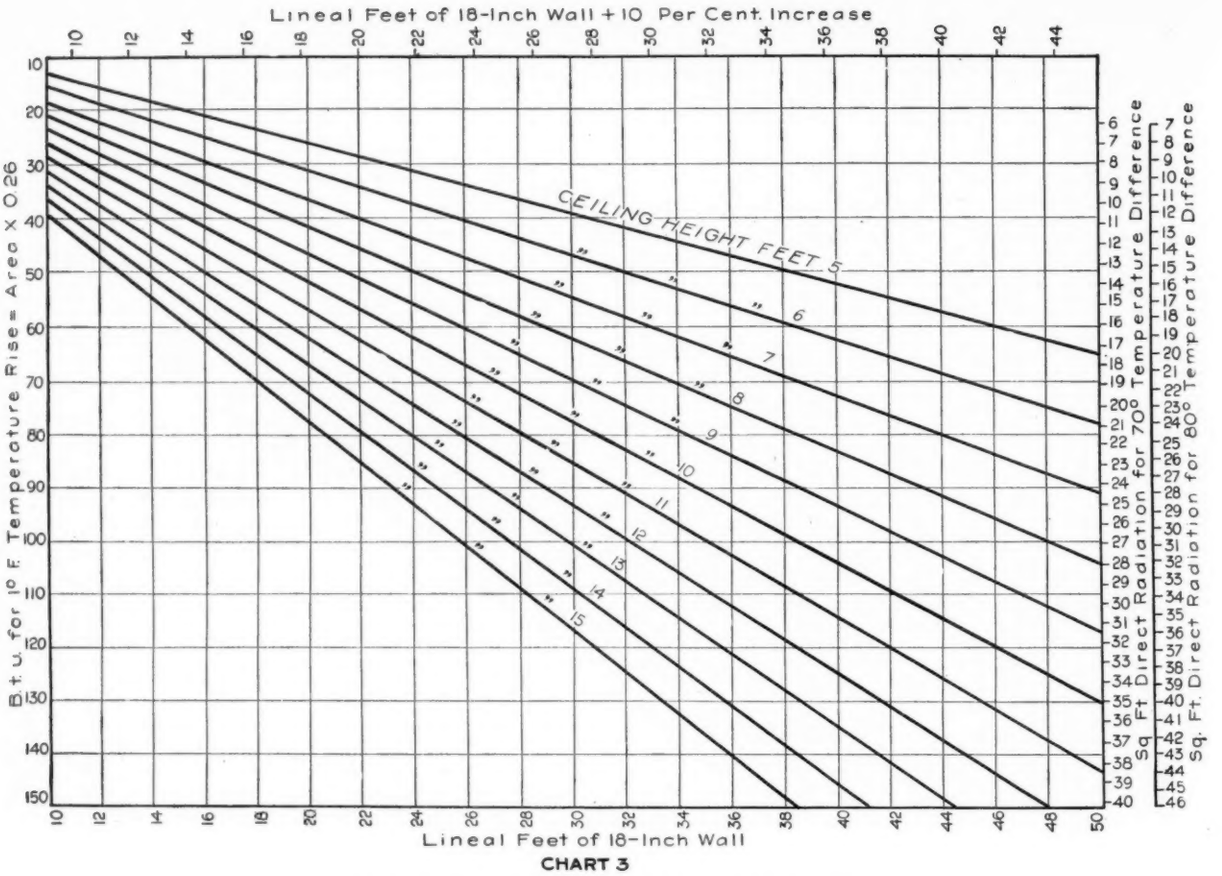

Lineal Feet of 18-Inch Wall + 10 Per Cent. Increase
B.t.u. for 1° F. Temperature Rise = Area x 0.26
CEILING HEIGHT FEET 5
" 6
" 7
" 8
" 9
" 10
" 11
" 12
" 13
" 14
" 15
Sq. Ft. Direct Radiation for 70° Temperature Difference
Sq. Ft. Direct Radiation for 80° Temperature Difference
Lineal Feet of 18-Inch Wall

CHART 3

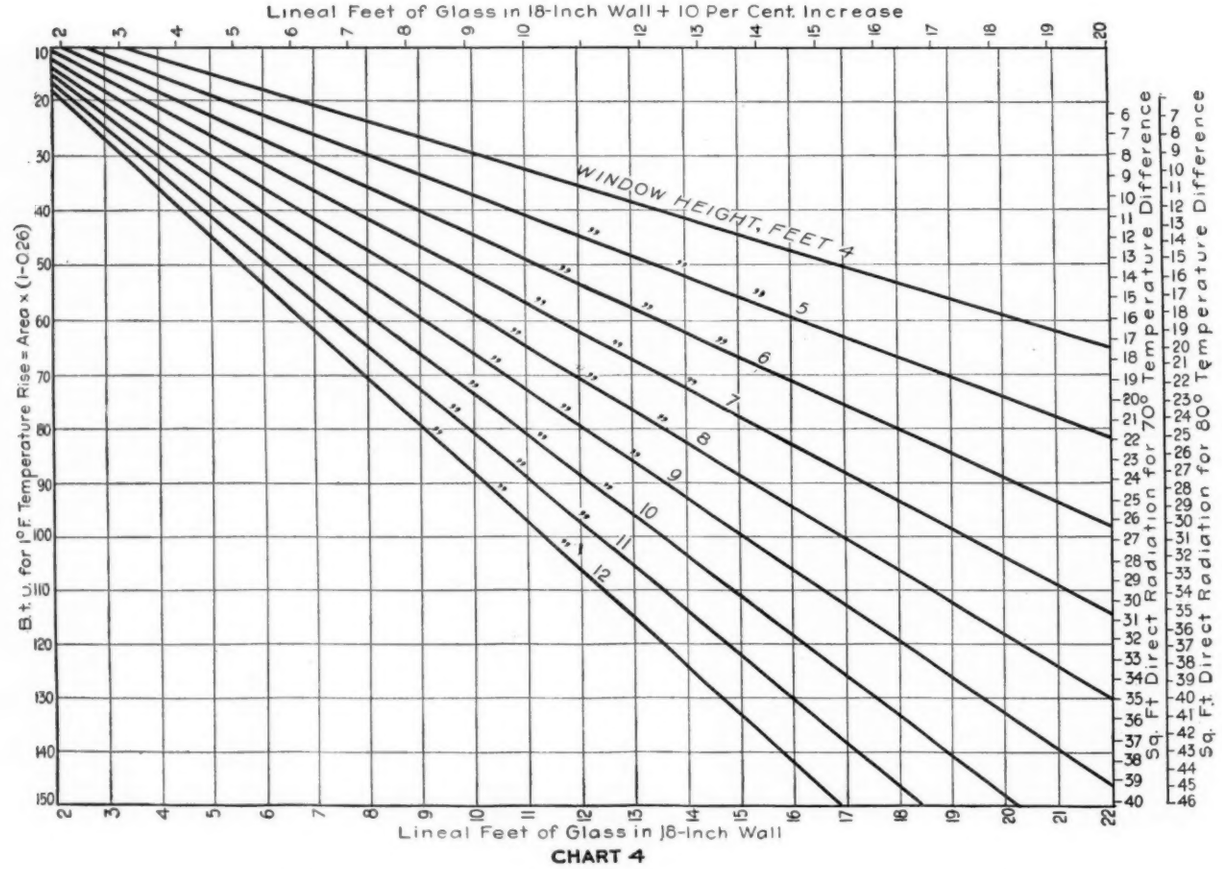

Lineal Feet of Glass in 18-Inch Wall + 10 Per Cent. Increase
B.t.u. for 1° F. Temperature Rise = Area x (1-0.26)
WINDOW HEIGHT, FEET 4
" 5
" 6
" 7
" 8
" 9
" 10
" 11
" 12
Sq. Ft. Direct Radiation for 70° Temperature Difference
Sq. Ft. Direct Radiation for 80° Temperature Difference
Lineal Feet of Glass in 18-Inch Wall

CHART 4

TOTAL RADIATION FOR 18-IN. WALL IS THE SUM FOUND BY CHARTS 3, 4 AND 7

Chart 3—Square feet radiation per square foot exposed 18-in. wall. Chart 4—Square feet radiation per square foot of glass surface

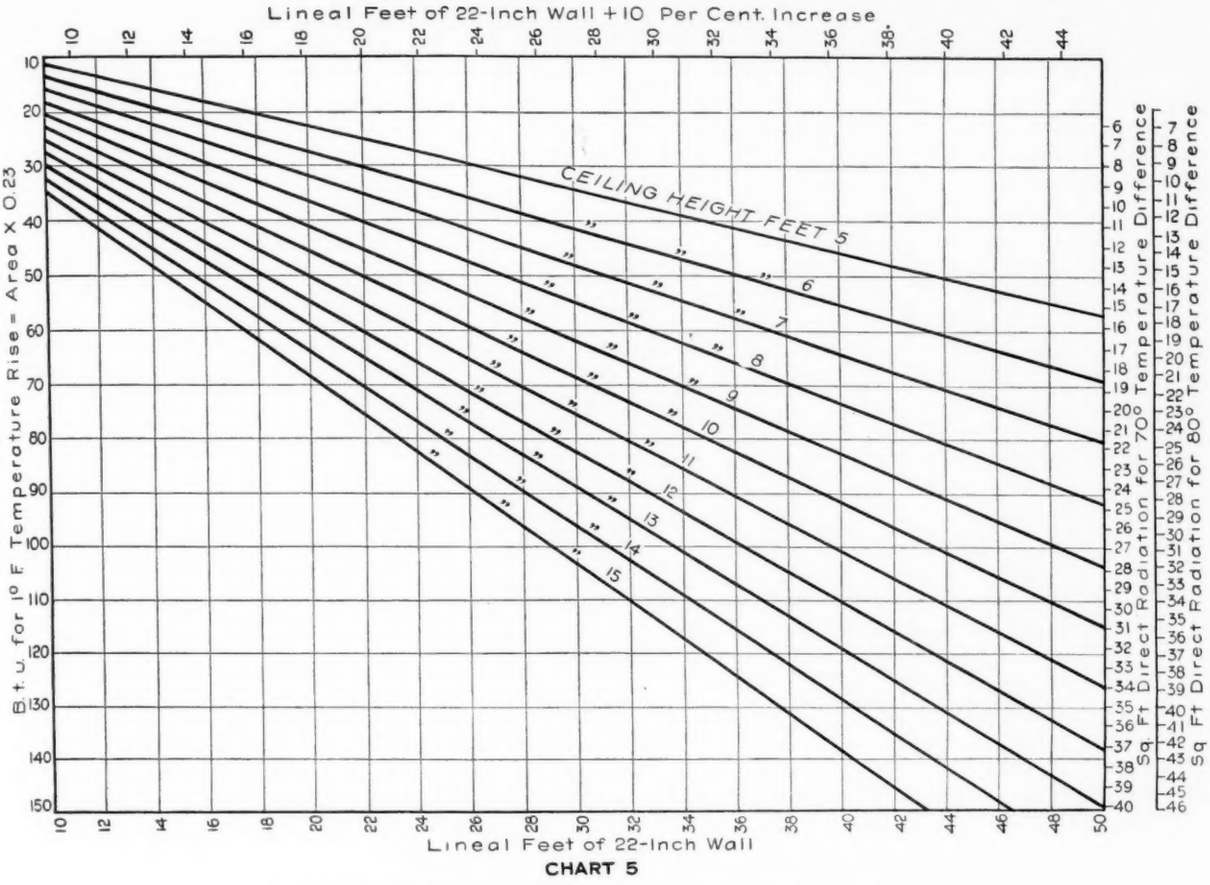

Lineal Feet of 22-Inch Wall + 10 Per Cent. Increase
B t u for 1° F Temperature Rise = Area X 0.23
Sq Ft Direct Radiation for 70° Temperature Difference
Sq Ft Direct Radiation for 80° Temperature Difference
CEILING HEIGHT, FEET 5
" " 6
" " 7
" " 8
" " 9
" " 10
" " 11
" " 12
" " 13
" " 14
" " 15
Lineal Feet of 22-Inch Wall

CHART 5

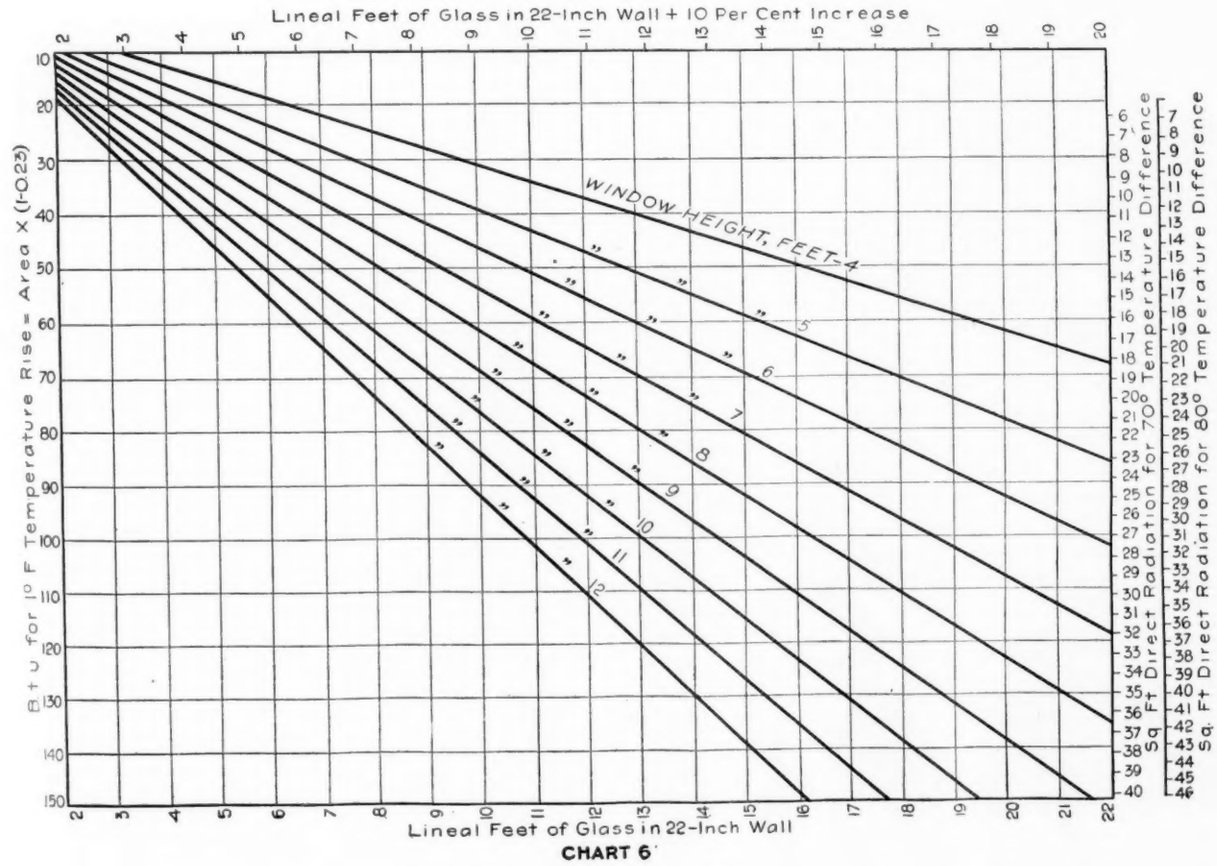

Lineal Feet of Glass in 22-Inch Wall + 10 Per Cent Increase
B t u for 1° F Temperature Rise = Area X (1-0.23)
Sq Ft Direct Radiation for 70° Temperature Difference
Sq Ft Direct Radiation for 80° Temperature Difference
WINDOW HEIGHT, FEET 4
" " 5
" " 6
" " 7
" " 8
" " 9
" " 10
" " 11
" " 12
Lineal Feet of Glass in 22-Inch Wall

CHART 6

TOTAL RADIATION FOR 22-IN. WALL IS THE SUM FOUND BY CHARTS 5, 6 AND 7

Chart 5—Square feet radiation per square foot exposed 22-in. wall. Chart 6—Square feet radiation per square foot of glass surface

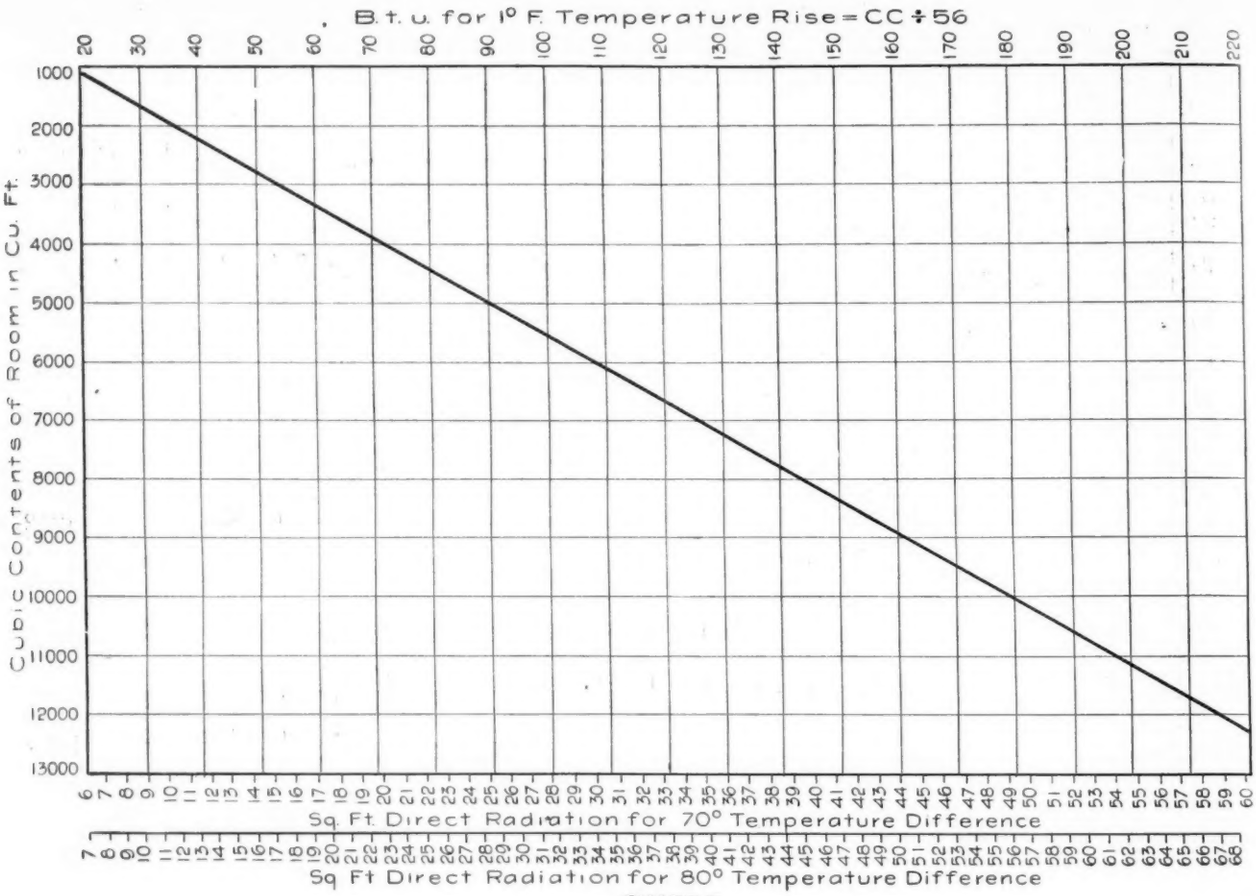

B.t.u. for 1° F. Temperature Rise = CC ÷ 56
Cubic Contents of Room in Cu. Ft.
Sq. Ft. Direct Radiation for 70° Temperature Difference
Sq Ft Direct Radiation for 80° Temperature Difference

CHART 7

SQUARE FEET RADIATION TO BE ADDED TO TAKE CARE OF NORMAL AIR CHANGES

Suppose the room is 20 ft. deep, how much would be allowed for leakage? The general rules would be: One air change per hour—or use your own judgment. Authorities allow the greatest freedom.

To allow one air change per hour for a room that is as deep as it is high conforms closely with good practice. Thus if the total lineal feet of exposed wall is multiplied by the height squared, and the product is assumed to be the air change per hour, the approximation for shallow and deep rooms will be as close to practice as a good guess. The cubic contents of Chart 7 refer to the air changes figured in this way. Thus in the example, if the room is 20 ft. deep, it will have the same air leakage as if it were 10 ft. deep, and the equivalent cubic contents would be $24 \times 10 \times 10 = 2400$ cu.ft., requiring 12 sq.ft. of direct radiation for a 70-deg. temperature difference. If the problem considered a corner room 20 ft. deep, the equivalent cubic contents would be $(24 + 20) \times 10 \times 10 = 4400$ cu.ft. Thus, in the room of the example given, the total radiation required would be (the sum by Charts 1 and 2 = 34) $34 + 12 = 46$ sq.ft. of radiation.

The accompanying table gives the values of K (B.t.u. loss per square foot of surface per hour for one degree temperature rise) for the usual building materials and the three thicknesses of brick wall for which the charts are constructed. It will be noticed that the charts cover the usual run of building materials.

Although some of the constants in the table do not agree with any particular authority, each of them lies within the limits given by the different authorities and most of them approximate the average. The widest variation from the average introduces an error in

COEFFICIENTS OF HEAT TRANSMISSION AND BUILDING CONSTRUCTION

Material:		B.t.u. per sq.ft. surface per hour for 1 deg. temp. rise		
		0.23 (Chart 5)	0.26 (Chart 3)	0.32 (Chart 1)
Walls	Brick	22 in.	18 in.	13 in.
	Wood clapboards	Sheathed, paper-lined and plastered	Sheathed and paper-lined	Sheathed
	Partitions, wood and hollow tile			Lath and plaster both sides
Roofs	Tin			Sheathed
	Shingle			Sheathed
	Tar and gravel			Sheathed
	Concrete	13 in.	9 in.	5 in.
	Ceiling under			¼ of above constant
Doors	Wood	(Use one-half of values in glass charts, 2, 4 and 6)		
	Glass	(Use the glass charts, 2, 4 and 6)		

square feet of radiation which falls within the size of the nearest commercial radiator section available. The formulas from which the charts were plotted are: For the brick walls,

$$H_w = A \times K_w \qquad R_w = \frac{A \times K_w \times 70}{260}$$

where

H_w = B.t.u. per hour per degree temperature difference;

A = Area of wall, including windows, in square feet;

K_w = Unit heat loss for the wall;

R = Square feet of direct radiation for 70 deg. temperature difference;

70 = Temperature difference between outside and room temperatures;

260 = B.t.u. dissipated per square foot of radiation, with steam at atmospheric pressure and the room at 70 deg. F.

For glass in walls,

$$H_g = A \times (1 - K_w) \qquad R_g = \frac{A \times (1 - K_w) \times 70}{260}$$

For the air leakage.

$$H_a = \frac{CC}{56} \qquad R_a = \frac{CC \times 70}{56 \times 260}$$

where CC = the cubic contents of room figured as previously explained and 56 = the cubic feet of air raised through 1 deg. by 1 B.t.u.

All of the charts are for steam radiation. They will serve for hot-water radiation by applying the proper ratio of heat dissipation between steam and hot-water heating surface.

A Plugged Water Outlet Causes Ammonia Condenser Trouble

By E. W. Miller

When the weather began to get warm last spring, the refrigerating system in a combined power and refrigerating plant gave trouble by excessive head pressure. The plant had been run for several seasons and at times heavily loaded, and at no time, even in the warmest weather and with warm water, had the engineers had trouble of this kind. The previous season they had driven an artesian well, and this gave water at approximately 60 deg. at all times, where before the city water had often been as high as 75 deg. This should, if anything, be conducive to lower condenser pressure.

The supply for the condenser was taken from the main line to the rest of the plant, and normally the valve in the branch to the condenser was opened only a couple of turns, the pressure on the main line being about 50 lb. This time, however, it was impossible to keep the condenser pressure down to normal or even ten to fifteen pounds higher with only a light load on the machine and the water valve in the branch to the condenser wide open. It was evident that when hot water came on, serious trouble would be experienced. Everything that could be thought of was tried. The condenser was purged for foul air and gas so often without results that it became patent to everybody that this could not be the cause of the trouble. Then somebody suggested that probably the gates in the stop valves in the feed or return lines of the condenser might be defective, but this was not the case. By testing the individual stands by opening the stop-cocks at the top, it was found that every stand had an unobstructed flow through it and that there was plenty of pressure on the water.

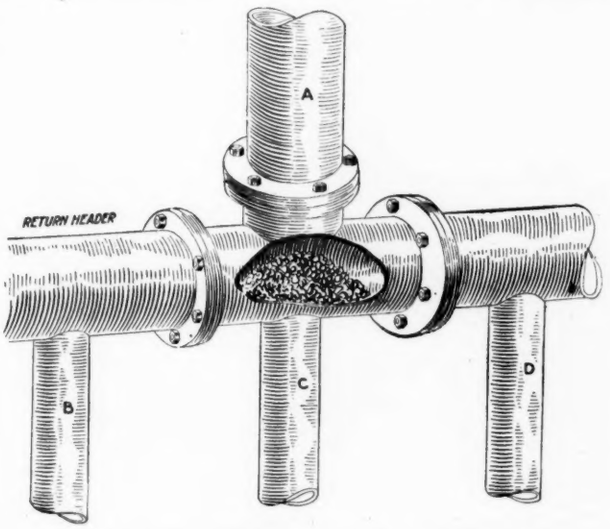
After they had experimented for over a week without results, the writer was called in to see if he could locate the trouble. The condenser pressure had gradually increased until at this time it was about 200 lb., whereas normally it seldom went above 160 lb., generally less.

In talking the thing over with the chief, I suggested several probable causes for the trouble and found that he had already anticipated them and satisfied himself that none of them was in evidence. We finally went out to the condenser, and I was surprised to find that every stand was sizzling hot, indicating that each one was doing its share of the work. I next opened the cock at the top of one of the stands and was still more surprised to find that the water coming out was steaming hot. There was plenty of pressure, however, and after it had been running a short time with the cock open, the water cooled off until it was only slightly warmer than when it entered. Leaving the cock on this stand open and letting the water run in the sewer from the floor under the condenser, I went along and opened a few more of the cocks at the tops of the stands, with the same results.

While we were still experimenting, one of the oilers came out and informed us that the head pressure had dropped to about 160 lb. It was now evident that the trouble was due to lack of water and the cause apparently was something in the return, as there was plenty of pressure on the condenser.

The accompanying sketch illustrates the water connections on the return end of the condenser, and will be readily understood by anyone who has seen one of these condensers. The return-water line is indicated by *A*, the return header is shown and the individual stands are indicated by *B*, *C* and *D*.

In the line *A*, just a few feet back from the tee, there was a connection made for a gage. By inserting a gage



WHEPE THE RETURN HEADER WAS PLUGGED

at this point we found that the pressure was only about a pound or two. We next went out to the reservoir into which the return line emptied and were surprised to find that only a small stream of water was coming out. Evidently there must be some obstruction in the return line or header.

We next disconnected the return line and found the tee filled with a white lime-like substance that practically shut off the flow through the tee. The deposit was soft enough so that it could be cut with a knife, and in a short time we had dug it out. We then reconnected the line, and when the machine was again started, the condenser pressure went no higher than 135 pounds.

We were at first badly puzzled to account for the presence of the deposit, but the chief finally hit upon

the solution. During the winter, in overhauling the condenser, the pipes in the stand connected to the tee, shown in the center of the sketch, had been removed. In testing for leaks it was found that this stand had a split water pipe. On removing the pipe it was found filled with the same deposit in a mushy form. It was apparently due to the heavy scale-forming deposit in the well water which, combining with the ammonia, formed the lime-like deposit. Part of it had evidently accumulated in the tee and, while the condenser was shut down during the winter, had hardened so much that the water pressure was unable to force it out.

Arrangement for Lifting Intake Screens

In contrast with the usual permanent intake-screen lifting apparatus used by small stations, the tripod and chain hoist illustrated herewith is thought to be a model of simplicity and inexpensiveness by the company using it. It is in service at the intake of the 1000-kw. steam-turbine plant of the Crawfordsville (Ind.) Electric Light and Power Co. The outfit consists of three spliced lengths of old boiler tubing

SIMPLE DEVICE FOR LIFTING INTAKE SCREENS

and a 1-ton chain hoist. The two legs of the tripod that are adjacent to the stream are of equal length, but the third leg, which rests back from the bank of the river, is longer than the others to give workmen plenty of room to handle outcoming or ingoing screens. F. H. Miller, manager of the Crawfordsville plant, states that the outfit performs its work admirably and was inexpensive to construct.—*Electrical World.*

In apparatus subject to very heavy overloads for relatively short periods, excessively high temperatures may be attained by the copper inside the insulation. Experience has shown that frequently local temperatures of 200 to 300 deg. C. are attained for short periods.

Ordinary commercial solders will soften at about 170 to 180 deg. C., while pure tin solders will soften at about 220 to 230 deg. C.

Home-Made Wire Straighteners

By M. P. Bertrande

Frequently about the power plant are rolls of wire, of every description, which no one seems to want, just because it is not straight. It was for the utilization of this wire that I came to rig up wire straighteners. They are so easily built and occupy so little space that no power house should be without one.

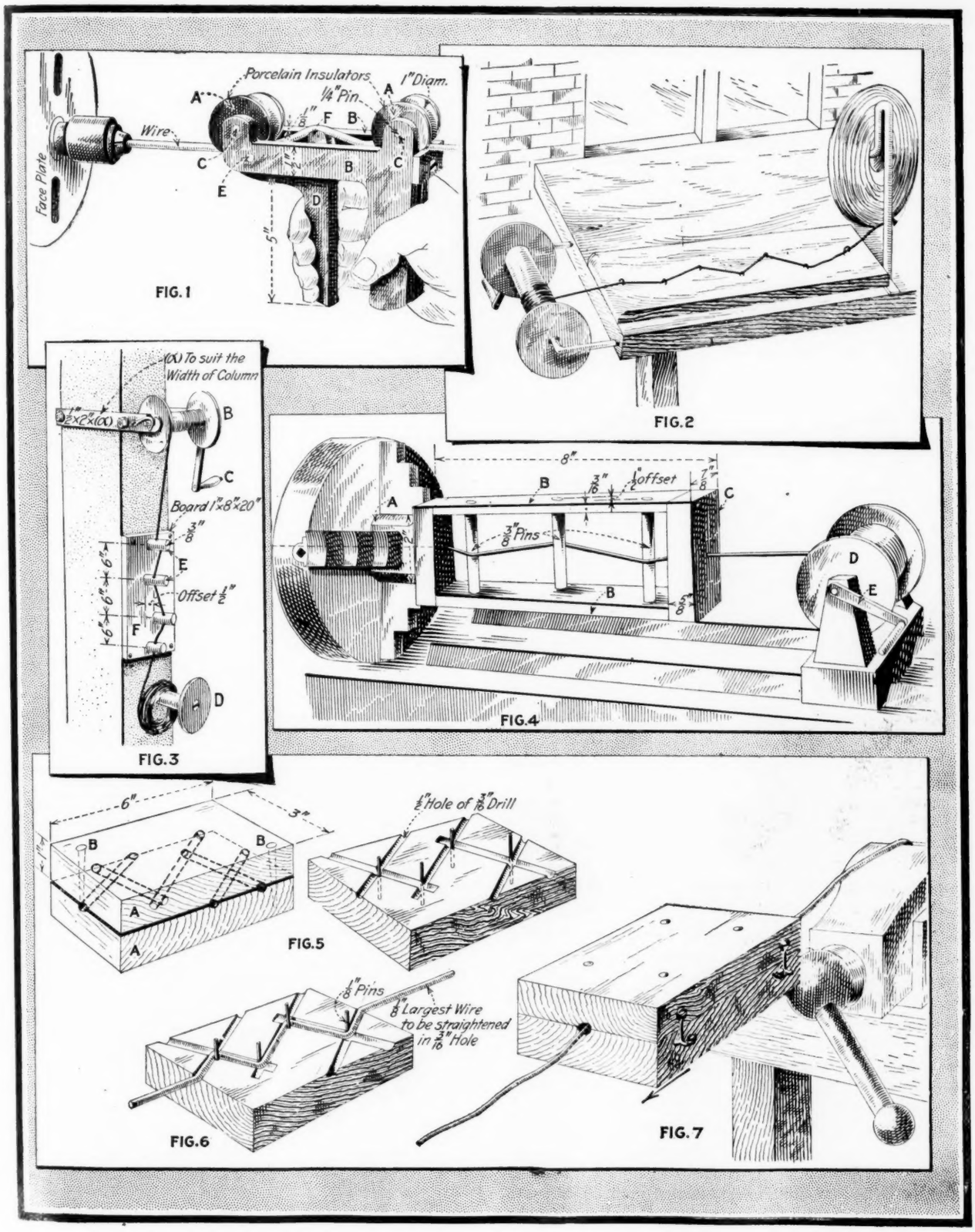
A very efficient and yet simple wire straightener is the one shown in Fig. 1. It is made of $\frac{1}{8}$-in. sheet steel and two porcelain insulators. Two insulators *A* are held by the two shoulders *B* and the pins *C*. The adjusting or movable blade *D* is fulcrumed at *E* and is made of $\frac{3}{8}$-in. stock with a groove to receive the wire in the straightening end *F*. When the wire is gripped in the lathe or vise, the tool is applied as shown, and pressure exerted on the handle *D* as required; then the tool is moved along the wire. This tool may also be used out on the job.

In Fig. 3 is shown a column that, besides holding up the roof, acts as a support for the straightener. Two iron straps fastened to the column by means of two long bolts are holding the spool *B*, which is turned by the crank *C*. The bent wire is placed on the spool *D*, passes through four wooden pegs *E*, fastened to the board *F* on the column, and goes up to the spool *B*.

Another straightener on about the same working principle as the one described is shown in Fig. 2. The end of the workbench is the most suitable place for it, where it will not interfere with other work. In this case, the wire passes through heavy staples instead of wooden pins. The number of staples depends upon the size of the wire to be straightened; as the diameter of the wire increases, the smaller the number of staples used.

If a lathe is available, a straightener can be easily rigged up as shown in Fig. 4. On the chucking boss *A*, four pins support the plates *B*, which in turn support the end plate *C*. Three pins are inserted off center to the holes through the end plates. The bent wire is passed through the hollow spindle of the headstock, alternately around the straightening pins and finally through the end plate *C* onto the receiving spool *D*, which is fastened to the lathe carriage. The lathe is now set in motion, and the spool is turned by the crank *E*, thus receiving the straight wire. This device is used for straightening bare or insulated copper wire or steel wire up to and including sizes $\frac{1}{4}$ in. diameter. For larger-size copper, increase the length of the plates *B* and the diameter of the pins; also reduce the offset of the pins.

A portable wire straightener which is very light and easily made is shown in Fig. 7. Two hardwood blocks *A* are cut as shown in Fig. 5 and held together by two screws *B*. Five $\frac{3}{16}$-in. holes are drilled where the two blocks meet, in the direction shown by the dotted lines, being sure that the holes will intersect each other as in the figure. The two half-blocks are then separated, and the corners are reinforced with $\frac{1}{8}$-in. pins, Fig. 5. These also act as locating pins for the groove of the upper half of the block. The wire is then located as shown in Fig. 6, the top block placed over and locked by the side hooks, Fig. 7. Then by sliding the straightener along the wire a straight conductor is obtained.



FIGS. 1 TO 7. SHOWING DIFFERENT DEVICES THAT CAN BE EASILY MADE FOR STRAIGHTENING BENT, BARE OR INSULATED COPPER OR STEEL WIRE

Fig. 1—Adjustable hand wire straightener. Fig. 2—Wire straightener made with staples and a piece of board mounted on a workbench. Fig. 3—Wooden-pin wire straightener located on a building column. Fig. 4—Heavy wire straightener for use in a lathe. Figs. 5 to 7—Parts and assembly of a hand wire straightener

Improved Moloch Stoker

Since the Moloch underfeed stoker was described in *Power* of Nov. 7, 1916, improvements have been made in the stoker valve and in the device timing the strokes of the ram. For the first time a cutoff has been applied to a steam-operated underfeed stoker. The electric- and steam-type valves then in use have been supplanted by an automatic cutoff valve actuated by a new design of timer. The latter is operated in conjunction with the forced-draft equipment, all of which is regulated by the steam demand on the boiler, so that, as before, the air and fuel are maintained in proper proportions to each other for all load requirements.

The timer is a pilot valve of the rotary-disk type provided with four ports controlling the steam admission of the main valve on the stoker. It is driven from

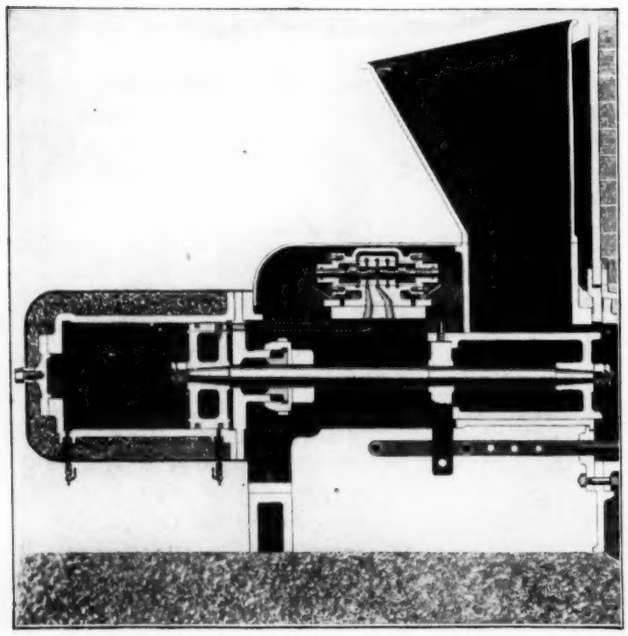


FIG. 1. SECTION THROUGH STOKER, SHOWING AUTOMATIC CUTOFF VALVE

the fan equipment by belt, the proper speed reduction being effected by a worm gear. The intervals of valve rotation, and therefore the strokes of the ram from 0 to 200 per hour, are controlled by a selective disk transmission set by means of a handle on the face of the timer. The working parts of the timer are enclosed in a dustproof casing and are operated in oil. There is one timer for each retort, so that each stoker of a multiple unit is independent of the others. A shutdown of one element would not affect the entire unit.

Each timer is located in near proximity to the stoker it serves, the connection between being two small steam pipes. One supply and one exhaust main common to all stokers run the length of the installation. The connections to an individual pilot valve are made through cored passages in the timer body, so that the working parts may be removed without disturbing the steam lines. Fig. 2 shows the timer and pilot valve, also the working parts of the timer.

The main stoker valve, which is mounted on top of the ram casing between the cylinder and the coal magazine (Fig. 1) is of the piston type. It consists of two elements, each made up of one small and one large piston mounted on a common rod. The two elements are placed horizontally and in line on either side of a central chamber, with the small pistons adjacent. At either end is a larger piston subject to steam pressure on its outer face. With steam on the central and outer chambers, the two elements assume their inward or normal position, due to the greater pressure on the larger pistons. Steam to the valve comes from the main supply header; to the central chamber direct, and to the end chambers through the pilot valve controlled by the timer. When the latter releases the pressure on either end, the pistons on that side move outward, uncovering the steam port to one end of the stoker cylinder and admitting steam from the central chamber to the ports in the stoker cylinder.

Following the usual cycle, the stoker piston which drives the ram first moves on the outward stroke. At the end of the stroke a pin on the ram strikes a lever whose opposing end cuts off the steam supply and opens the exhaust. Steam is admitted to the end chamber to hold the valve in its normal position. The timer then causes the same events to take place on the opposite end of the valve, effecting the in-stroke of the stoker ram and thus completing the cycle of its operation.

With the short connections between the valve and the cylinder, it will be evident that the clearance is small. Discontinuing the steam supply as soon as the work of the piston is completed, minimizes the use of steam for operation. Lagging the cylinder also improves the economy by reducing loss by radiation. A

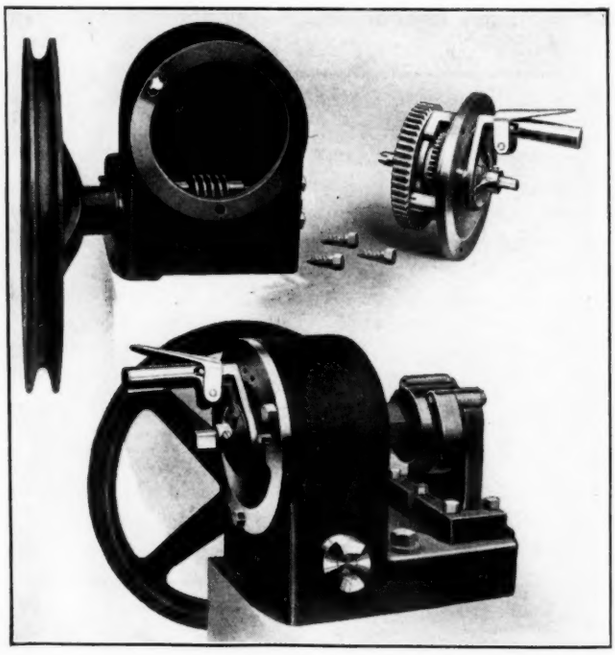


FIG. 2. TIMER AND PILOT VALVE AND TIMER DISMANTLED, SHOWING WORKING PARTS

feature favoring convenience of operation is the arrangement of the design whereby all working parts of the stoker and timer, such as the valves, the disk transmission, the cylinder, piston and ram, may be removed without opening any of the steam connections.

Editorials

Over There and Right Here

OVER THERE, as our artist has pictured in the colored supplement to this issue, American boys are fighting to put down the whirlwind of destruction which German rapacity has let loose upon the world.

They need food and clothes and guns and ammunition and airplanes and motor trucks and medical supplies and fuel.

Because the Italians did not have these things, the seething line of compounded cruelties has been thrust far forward and the struggling monster, in exulting encouragement, grins with new defiance at the consternation of an outraged world.

We cannot all go to the front to help put out this conflagration. It would be useless if we could. Somebody must stay at work to make and transport the things that our soldiers need. Italy has plenty of soldiers. It was the lack of the products of labor, of steel and coal and ships and cars to transport them in, that caused her and our disaster, that is likely to add so materially to the duration and cost of the war.

There is one great task before the world today—to stop this war. And there is only one way to stop it, and that is by so thoroughly beating those who are responsible for it that never again so long as the race endures shall any ruler or any people dare to hope that such international and inhuman outlawry can succeed.

The entire resources of the country must be organized for this purpose. Any man who slacks or shirks is a traitor not only to his country but to humanity. Any producer of food or fuel or other of the necessities of life or war who fails to do his utmost to meet this emergency demand is as guilty as the soldier who refuses to fight. Every manipulator who schemes to exploit this crisis for his private gain and, by extortionate prices, increases the burden of the war upon the toilers who are fighting it at home as well as are the soldiers at the front is outside of the pale of peace-time law and should be summarily dealt with. Any workman who fails to get the most out of our limited and insufficient equipment, who does not work as though his boy were at the front and the life of that boy depended upon the result of his labor, is no true American; and any workman or combination of workmen that interferes with the orderly, efficient production of the maximum output of which our mines, farms, workshops and shipyards are capable and its prompt and speedy transportation and distribution is shooting our boys in the back and should be treated as seditious.

If everybody will do all that he can and avoid unnecessary consumption and waste, there will be enough for everybody—our soldiers, our allies and ourselves. Our own people will buckle to it with a will and cheerfully support the sacrifices that they must make when they are satisfied that their extra effort and privations are not for the benefit of profiteers and opportunists.

There Can Be But One Answer

ACCORDING to statistics recently completed by the Department of Labor at Washington, there have been reported to the Government since April 6, 1917, when a state of war with Germany was declared, no less than five hundred strikes and other industrial disturbances. These statistics cover a period of almost six months and show that 1,029,671 workmen have been affected. In the corresponding period in 1916 only one hundred and forty-four strikes occurred. Up to the time these Government records were completed, of the five hundred strikes that official attention had been called to, one hundred were still in force, fifty were given up as impossible of adjustment and forty-eight were left in a partly adjusted condition, the remainder being settled in one way or another.

Add to the foregoing Government records what we have seen in the three most important industries in this country—coal mining, railway transportation and shipbuilding—and the outlook is anything but encouraging. Just in whatever degree the first two fail to meet the needs of the country, just to that degree is industry hampered and to the same extent we fail to accomplish our end in this great conflict. One has only to consider the importance of ships to England, with only approximately twenty miles of water between her and the western battle front, to see how vastly more important the question of ships is to us, who have nearly three thousand miles of water between us and the coast of France. When President Wilson was making his appeal before the American Federation of Labor for the coöperation of labor to see to it that "The power of this country and the productivity of this country is raised to its absolute maximum and that absolutely nobody is allowed to stand in the way of it," he said: "If we are to do this great thing and show America to be what we believe her to be, the greatest hope and energy of the world, then we must stand together night and day until the job is finished." Yet in the face of this appeal we saw the next day six thousand men in the shipbuilding industry go on strike at Newark, N. J., not considering the thousand of workers that are, or have been, on strike in this all-important industry in other parts of the country.

At approximately the same time members of the four railway brotherhoods were voting secretly for a wage increase estimated at $109,000,000, which is approximately twice the amount obtained through the Adamson Law. In the coal-mining industry strikes have been common, everyday occurrences. The way that other industries vital to the successful prosecution of the war have been affected by labor disturbances is only too well attested to by the foregoing statistics.

Such conditions, when the nation is face to face with the momentous task of bringing this titantic struggle between tyranny and democracy to a successful and

honorable termination, may well cause every sincere, patriotic American to ask the question, What is the outcome going to be? True, labor has not been to blame for these interruptions in all cases. Manufacturers in some instances have attempted to make Government work an excuse to decrease wages or to increase working hours without an increase in wages. But the fact remains that Government work has been frequently tied up because some of the materials used in the work were not produced by union labor. Such a thing might in some cases be justifiable in times of peace, but in war time it can be considered nothing short of being unpatriotic and taking advantage of a national emergency to force certain selfish ends that could not be obtained otherwise.

Unless labor and capital are willing to forego their selfish interests and with unswerving allegiance to the cause of freedom and democracy devote their energy to the prosecution of this conflict to a successful ending, there can be but one answer, and this was very impressively expressed by H. W. Garrod, Deputy Assistant Secretary of Labor Regulation Department to the Special Mission of British Ministry to the United States in an address before the Editorial Conference of the New York Business Publishers' Association, New York City, Nov. 13, 1917. Abstracts of Mr. Garrod's address and those of the other members of the special mission appear elsewhere in this issue.

Mr. Garrod, in summing up his observations of labor conditions in this country, said: "I will just add one other word, if I may, which I hope won't be taken as being anything in the nature of advice or criticism. Since we have been in this country, a period now of nearly ten weeks, we have been witnesses from a distance of a very considerable number of trade disputes which have been, so far as we could judge, serious, and in some cases, prolonged. But what I want to say is that if one-eighth—I think that is no exaggeration—of the industrial troubles which we have witnessed in this country in the last two months had taken place in England, over the whole period of the last two years, we should long ago have been compelled in England to sue for disgraceful peace. That, I think, gentlemen, is a serious and solemnizing reflection, and I want to leave it to you without comment."

The Problem: To Burn the Lower Grades of Coal

ONE hears talk about increased coal production. Being a user, one likely has asked oneself: How much of the increase in tonnage output is incombustible refuse? At least one manager of a great central-station company is reported to have stated that per unit of output twenty per cent. more of the "stuff" his company must use is required over what was the coal consumption in pre-fuel-disturbance days. Of course it is better to have "stuff" than no fuel at all, and as this is a sellers' market with coal buying on specification only a memory, engineers must learn how to use what is available.

Two things seem certain: First, as a people we shall, because of these wartime lessons, discontinue skimming the cream of the coal from the mines; second, as engineers we must more widely use the stoker, must forget the not very old doctrine of setting a minimum boiler-horsepower limit below which it is uneconomical to use stokers, and vigorously prosecute the work, most of which is already done, of adapting the stoker to the fuel, on the one hand, and the fuel to the means of burning it, on the other.

It is the opinion of this paper that hand-firing, for soft coal, must go. The variety of stokers now available shows that no mean effort has been and is being made to meet the economical and social (labor) objections to hand-firing. The smoke inspectors of the smoky-coal sections of the country have long preached the stoker gospel, experience having convinced them that stokers, together with the enforced, or at least wider application of the knowledge of necessary furnace volumes and gas-path area ratios as related to the grate area, are the only stable solution to the smoke-abatement problem as presented by steam-power plants. The fact is the more cogent now that the realization is borne home that the poorer fuels must be burned—not at some distant day, but now.

It is significant that stoker and furnace designers, as well as combustion experimenters, have developed, on the whole, faster than engineers and firemen have learned how to make use of the knowledge made public and directed especially to them. It is therefore important that those who will ultimately fire or supervise the firing of coal learn how to do it most advantageously.

The disturbance of transportation has forcibly taught the lesson of using the fuel nearest the place of consumption, except where water routes, with short rail hauls, expedite transportation, as from the West Virginia fields to New England via Hampton Roads. Industries in the lignite regions should more extensively use this fuel on stokers or by the powdered systems that burn the fuel in suspension.

Exploiting a Crisis

THE power-plant owners of New England are receiving circular letters as follows:

Room 167 State House
U. S. Fuel Administration
James J. Storrow

Nov. 1, 1917.

Mr. ———

I am writing you at the request of Mr. Storrow, of the N. E. F. A. Because of the very real danger of a coal shortage in N. E. this winter, we have obtained from the Edison Co. a list of isolated power and lighting plants which could be taken over on the Edison system at once with a saving of a considerable quantity of coal, and in their opinion with no increased cost to the consumer.

Your plant is on the list, and we would greatly appreciate your making an early investigation of such a change.

You have doubtless given consideration to the question in the past, but in view of the present high price of coal, the uncertain supply and the fact that the Edison Co. is willing to meet the situation by making one year contract, would you be willing to discuss the matter afresh with one of their representatives? Very truly,

PHILIP ———,
Power Economy Dept.

The N. E. F. A. is the New England Fuel Administration and James J. Storrow is the Fuel Administrator for that geographical division.

Perhaps this perversion of his official functions to soliciting business for the Edison Company is done by Mr. Storrow in good faith. Perhaps he does not know

that a plant that has use for a considerable portion of its exhaust steam can make its power as a byproduct. The central station runs condensing and discharges over eight-tenths of the heat in all the coal it burns into the river. The isolated plant runs noncondensing and uses this heat for warming its buildings and in manufacturing processes. There are plants that would save coal by taking current from the central station. There are plants the abandonment of which in favor of purchased power would be an economic crime, and his letter is issued at the commencement of the heating season.

We wonder how he would regard a counter recommendation that power users who find that the use of central-station current has resulted in an increase rather that a diminution of their costs should be released from the contracts by which they are held to continue the practice.

The Committee on Coal Conservation of the Chamber of Commerce of the United States has issued a bulletin to the Owners and Managers of Power Plants containing recommendations the first of which is:

> Reconsider the advantage of buying heat and power from a specialized plant that makes nothing else and can afford the investment and supervision that gets the maximum of value out of each pound of coal; in some localities hydroelectric power may be available.

This is less brash, but still contains a suggestion of interested prompting. In only a few localities is a heating service available and the amount of coal burned by the central station to deliver power to a customer plus the coal burned by the customer to supply his demands for heat will exceed in many cases the amount of coal that would be needed to supply both services burned at the plant itself.

And then there is the vigorous movement on the part of those who are seeking to obtain control of the water powers to bend the present exigencies of the country to their purpose. Committees are established at Washington; a lively campaign to cultivate an overwhelming public sentiment in favor of turning these powers over to private promoters for at least fifty years, with no very definite procedure for getting them back and no positive control of their use of them in the meantime is being pushed. The columns of the business, technical and popular press are filled with their propaganda. Here is a sample from a long article, "Shall Power Vital in War and Peace Be Wasted Forever," by Edward K. Hall, vice president of the Electric Bond and Share Company, in the New York *Tribune* of November 11.

> Engineers estimate that ultimately 35,000,000 water horsepower will be developed when it is possible to secure the necessary Federal authority. Some of this requires the permission of Congress for the damming of navigable streams and some requires permission for the use of otherwise useless public lands, which permission no department of the Federal Government is adequately authorized to grant. This permission and authority have been the subject of discussion in Congress for several years, but action upon them has been repeatedly sacrificed on the altars of ill-founded theories and little conflicting interests.

The "ill-founded theories and little conflicting interests" are those of the real conservationists who do not want to see the control of the water powers of the country go the way that the people's control of their coal and oil and minerals and timber has gone. Their theories and arguments and objections have been reasonable and strong enough to convince legislators and hold up the attempted raid for a number of years.

The promoters can have the water powers as soon as they are willing to accept them upon the condition that they will develop them and sell the power at cost plus a fair profit and give them back at any time if the people want them back—which they will not so long as service is acceptable and charges fair—upon the restitution to them of all the capital that they have put into them with interest for the time that it has been in use with a chance to make a fair profit in the meantime. What do they want more?

We might add a comment on the scramble for an increase in rates on the part of the railroads that are doing more business with less investment than ever before in their history; on the effort of the street-railway companies to evade the order of the Public Service Commission to heat their cars on the ground that it will involve the burning of coal, etc.; but to the reader of the public prints or observer of affairs it is not necessary to multiply instances.

Listing the Boilers

HEINRICH, the systematic little German, in "Mr Britling Sees It Through," insists that the first essential to organization is a card index. The war has demonstrated, in a way that years of talking and writing would not so convincingly have driven home, the value of system and organization, the advantage possessed by him who knows what he has, what condition it is in and how it can most promptly and effectively be applied to a given purpose.

In years to come it will be difficult to realize in what a chaotic, unorganized condition the boiler situation in the United States has dragged along for years. Except in a few of the states, anybody can put up any old kind of a boiler, put any amount of pressure upon it and trust it to the care of anybody that he can get to run it. Nobody knows how many boilers there are in existence or turned out in a year. If a boiler explodes, there is no official record of its history and no official investigation of its cause, except it be that of a coroner's jury.

It is time that this condition was analyzed, systematized, and the boilers of the country card-indexed, the dangerous among them weeded out, intelligent supervision instituted over the rest, and a standard adopted which will insure that new installations are adequate for the strenuous conditions of modern practice. Some of the states are doing this. More are going to do it, and eventually we shall know how many boilers we have, how long each has been in use, and, when one explodes, why it happened and what should be done to prevent the frequent recurrence of such disasters.

Along the line of educating the engineer the Cooper Union is doing a good work in introducing a free night course of instruction in gas-engine practice, two nights per week, for the benefit of those engaged in operating, repairing or otherwise engaged with internal-combustion engines.

Toward the end of the week, when the grind begins to tell, we sometimes wish we were an engineer on one of those embargo-held liners that all summer have floated lazily in the breezes up the River.

Correspondence

Development of National Water Power

The great war in which our nation is engaged will be won not alone by food and men, but by mechanical power as well. Without mechanical power we could not make or move the weapons with which we fight—guns, ammunition, ships and supplies. Our national resources of power, whether from coal, oil or water power, are national war necessities. We need them to win the war.

In this gigantic struggle our security requires us to use all these great resources, and to use them wisely and well. The people of the United States own some fifty million undeveloped water horsepower, or about enough to run every train, trolley, factory, mill, mine and electric power plant in the country.

For ten years the friends of conservation have urged the development of public water powers in the public interest. But development has been held back by a little group of water-power magnates and their friends in Congress, who have blocked all legislation which would not give them these valuable properties forever and for nothing.

Today, when the nation needs all its resources, the same men who have been blocking reasonable water-power legislation own and are holding millions of water horsepower undeveloped and out of use while clamoring for more.

The time has come when such obstruction threatens the nation's safety and success. We need the development of these powers in war even more than in peace. At the coming session of Congress sound water-power legislation should be enacted as a war measure, based upon principles fair to all sides. These principles I believe to be briefly as follows:

The thing to do with water power is to develop it. Whatever retards or restricts the development of public water powers on terms fair to the public is against public policy and hostile to the general welfare.

Water power belongs to the people. The sites where it is produced should always be held in public hands, for only so can effective control in the general interest be secured.

Where public development is not desired, the right to use water-power sites should be leased for periods long enough to permit sound, attractive and profitable investment, but never longer than 50 years. At the end of each lease all rights should return to the people who gave them.

In order to protect the consumer against extortion, rates and service should be regulated by Federal authority when state or local authorities fail to do so.

Reasonably prompt and complete development and continuous operation, subject to market conditions, should be required. Already millions of water horsepower are held out of use to further monopoly by private corporations.

Corporations or individuals who make money out of rights granted by the people should share their profits with the people.

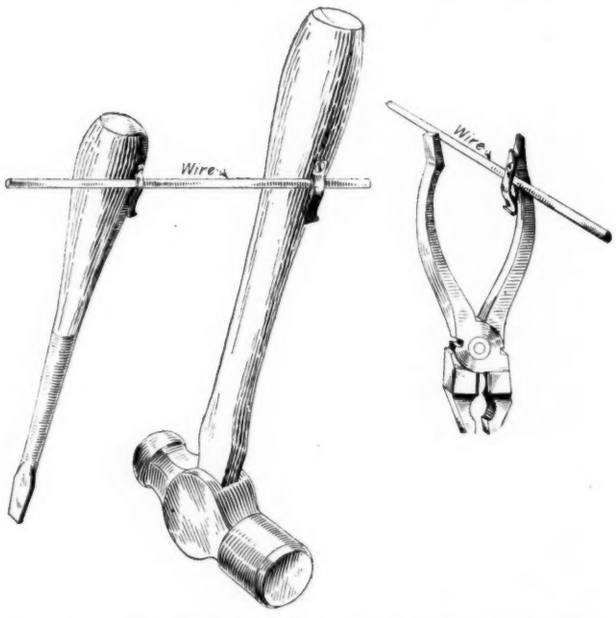
The public has a right to complete information about every business that is based on the use of public property.

These are the principles for which the friends of conservation have been contending. Many water-power men believe them to be fair and sound. I am writing to ask support for immediate legislation, based upon them, when Congress meets. This is no time to give away public assets necessary for the welfare of our people both in the war and after the war; and we should no longer tolerate the selfishness of private interests which take the dog-in-the-manger position that they must have these water powers on their own terms, or no one shall use them at all. As the President has said: "The supreme test of the Nation has come. We must all speak, act, and serve together."

Milford, Penn. GIFFORD PINCHOT.

Tool-Support Attachment

The little kink shown in the figure is very handy, and the electrician will appreciate its usefulness when he is working up on a ladder or pole with a half-dozen different tools to take care of. The attachment is made



METHOD OF SUSPENDING TOOLS WHEN NOT IN USE

of tool steel and hardened, and may be fastened to almost any tool handle used on lines inside or outside the power plant. While not in use tools so equipped can be easily hooked on the wires, where they will always be at hand. M. P. BERTRANDE.

Ozone Park, L. I.

Substation Equipment Layout

In Fig. 1 is shown the equipment layout of a substation that I was in recently and that is supposed to be modern and up to date in every detail. However, I have not seen in recent years a station so inconvenient or dangerous. First, look at the narrow passageway between the end of the alternating-current switchboard and the rotary-converter starting switch. At the end of the switchboard is a 2300-volt switch, and the potential of the starting switch is 432 volts. Three feet is a small space for anyone to pass through between the rotary converter and 600-volt switches on the direct-current switchboard. To pass the rotary-converter transformers, which are of the air-blast type, with the air blowing out the side next to the rotary, there is a space of about two feet to pass through. In doing so the attendant is liable to have any loose parts of his clothing caught in the revolving element of the converter. If this is called "Safety First," I fail to see it.

As for convenience, look at the position of the direct-current switchboard and the starting switch. Suppose the starting switch is thrown in and the rotary converter refuses to start; the distance to travel before the oil switch can be pulled out requires time enough for the machine to be badly burnt. Many unnecessary steps are taken also, that could be saved if the starting switch and direct-current switchboard were conveniently arranged, as in Fig. 2.

Again, the fans for the air-blast transformers are placed very close to the walls, so that if anything happens to the motor the fan has to be dismantled to get the rotor out, there being no space to take it out the other way; and the one on the high-tension transformers is entirely without a chance to work on it, because about one foot above the motor is placed a motor-driven air compressor on a platform. You almost have to lie down to work on this fan motor.

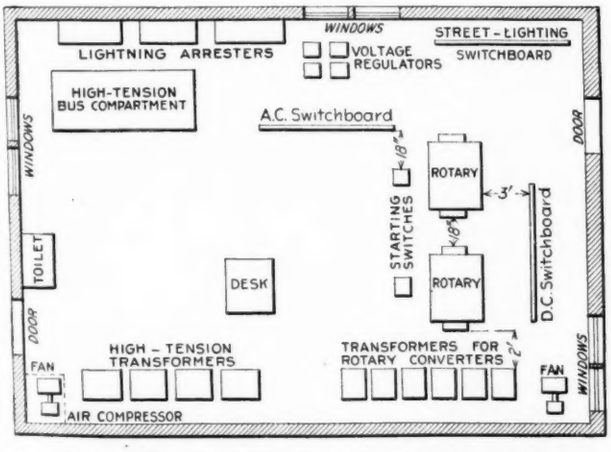


FIG. 1. ORIGINAL LAYOUT OF SUBSTATION MACHINERY

To reach the desk every person entering has to pass between the rotaries, between the starting switch and 2300-volt switchboard or by air-blast transformers.

Fig. 2 is a sketch of the station as I think it could be very conveniently arranged and practically built on the safety-first plan. The two boards are made in one, thus saving several steps in time of storm, when the circuit-breakers are opening frequently. In Fig. 1, the direct-current and alternating-current switchboards are far apart, necessitating many steps for the operator besides having to run between the machines. In this station we have had as many as 21 circuit-breakers open in 15 min. during a storm. The air-blast transformers are placed far enough away from the wall to allow the rotor of the motor to be taken out without taking the fan apart, and the air compressor has been placed in the opposite corner of the building, thus giving free access to the fan motor.

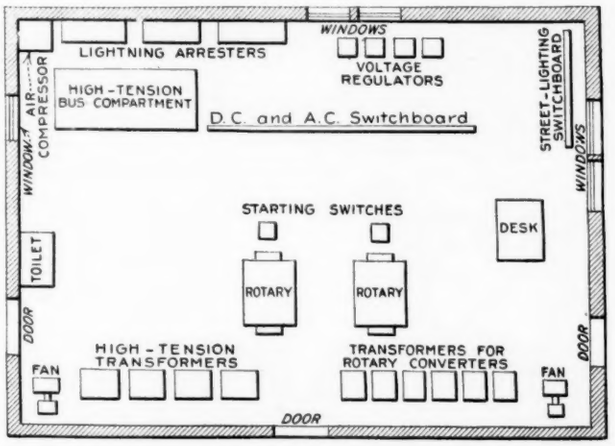


FIG. 2. IMPROVED LAYOUT OF SUBSTATION MACHINERY

W. H. NOSTAN.

Philadelphia, Penn.

Changing Watches in the Plant

It may interest readers of *Power* to know that the majority of British power stations work seven days a week with three shifts of eight hours each with no overlapping.

A change round is made every week by one shift, usually the night men missing a shift, and the others doing the alternate shifts until they return again. To avoid overlapping and to insure changing without interfering with the routine, in some stations the engine-room men change at 6 a.m., 2 and 10 p.m., the boiler-room men at 6:30 a.m., and 2:30 and 10:30 p.m., the switchboard men and engineers-in-charge, at 7 a.m., 3 and 11 p.m.

This method of changing shifts is rather cumbersome, but it has its good points as the engine- and boiler-room staffs are able to make reports and complaints to the engineer whose men they have relieved and he can then investigate for himself and see whether things are as reported or not and take the necessary steps in any case.

In large power houses where the day and evening load is very much heavier than the night load, two more sets of men are carried for the engine and boiler rooms. These two shifts work from 5:30 a.m. to 2 p.m. and from 2 to 11 p.m. and change about every week. They are usually the newer hands and are promoted to the 8-hour shifts as vacancies occur; they do not work Sundays or holidays when the load is light.

I was in charge of one 30,000-kw. plant for over six years and in that time did not have complaints about the previous shift more than six times; but before that, when in charge of a 2000-kw. plant, I had a grumble about every day. The trouble as a rule is caused by

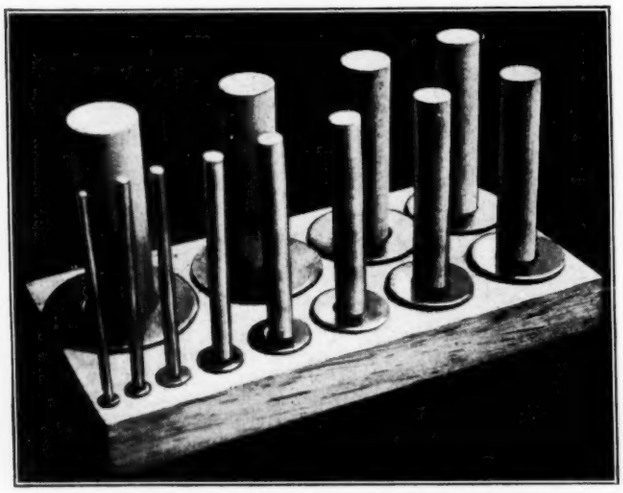
one man who will not do his share, and in consequence the whole staff is upset. The cure is to eliminate the idler. He will usually be recognized as the one who talks the most and works the least.

We do not have signed forms for complaints, as the time spent in filling them up is considered absolutely wasted. We use an open "logbook," in which all complaints and orders for operation are written. This book can be examined by any employee and appears to be quite satisfactory. D. S. REGAN.

Bradford, Yorkshire, England.

Holder for Assorted Washers

The photograph shows a washer holder that I use and find convenient for holding round cut washers; its construction and utility for shops and plants seems so obvious that a description is unnecessary. The same



PINS AND WASHER SIZES CONFORM

kind of holder might be used for holding a few of each size of nuts for current use, but their greater thickness makes the holder cumbersome if many are put on at a time. JOHN N. BOYCE.

Anaconda, Mont.

Motor's Speed Decreased

The amount of resistance in the rotor of an induction motor does not, within reasonable limits, affect the maximum torque of the motor, but it does affect the location of the maximum torque as regards the percentage of synchronous speed at which maximum torque obtains If the resistance is the maximum permissible, the torque will be a maximum at starting and will be less at the higher speeds. However, if the rotor resistance is increased too much, the rotor will be unable to start at all; such a condition would be produced if all the phases of a wound-rotor induction motor were open-circuited, in which case no secondary current could flow. Similarly, if continuous overloads or too frequent startings cause the solder to run out of the end connections of a squirrel-cage rotor, of the soldered end-ring type, the resistance of the rotor may become so high that it will be unable to start or, if it does start, will not attain more than half-speed, even with the compensator on the high side.

The operator of an amusement park complained that a swing was running considerably slower than when first installed. The electrician who investigated found that the operator had been trying to improve conditions by increasing the size of the motor pulley. Inspection disclosed that the slowing down of the motor was due to the fact that all the solder had been thrown from the rotor end connections. The rotor was taken out and sent to a shop, where the bars were removed, cleaned, tinned, reassembled and resoldered with hard solder and the rotor again installed. The motor then ran its load so fast that the operator called the electrician and asked him to slow down the swing. This was done by removing the large pulley, that had been used on the motor for speeding the swing before the rotor was repaired, and placing the original smaller one, which again gave normal operation. E. C. PARHAM.

Brooklyn, N. Y.

How Accidents Happen

Mr. Paige, in his article on "Experiences of an Erecting Engineer," in the issue of Oct. 23, page 569, says, "We wonder why there are so many serious accidents." One of the main reasons is that the fellows handling apparatus do not thoroughly understand it. Following is a case in point:

A switchboard operator and an oiler in a plant where I worked took it upon themselves one night to shut down a 500-kw. cross-compound Corliss unit. One shut down the engine and the other shut down the condenser, but without shutting the valve controlling the water supply. Of course the engine sucked up a cylinderful of water, and when the piston came back there was a bang! The engine stopped short and the very foundation seemed to give, but fortunately the cylinder head was not knocked out; the piston rod, however, was badly bent. During the operation of shutting down, both men stood at the rear of the engine cylinder, so that if the head had given way both would have been crushed against the condenser and probably killed. This, I think, is about the way half of the accidents happen—either to those who don't know or who don't think and go ahead without making sure. W. H. NOSTAN.

Philadelphia, Penn.

Putting In a Large Gasket

A short time ago it was necessary to remove the cast-iron head of a horizontal closed heater, about 5½ ft. in diameter, held in place by about 100 bolts. It would have been almost impossible to put it back on with a loose gasket which had to be spliced in several places, as common through bolts are used instead of studs. The job was accomplished without trouble, however, in the following manner:

The gasket was cut with a ball-peen hammer from heavy asbestos paper laid on the face of the head, and all splices were carefully made, after which the gasket was raised up, a little space at a time, and the bearing surface of the head painted with liquid glue and the gasket pressed down firmly all around. White lead would have done as well, as the object was to hold the gasket in place. This was done when the head was first taken off, and the glue had time to set before the head

was to be replaced. A clevis was put in the top hole, care being taken not to bruise the gasket, and the head hoisted up with the chain falls and a few bolts entered. The clevis was then taken out and the rest of the bolts put in and drawn up evenly, making a tight joint.

On a large surface of this kind it is frequently advisable to use asbestos paper instead of composition sheet packing, as it is cheaper and makes a thin and tight joint, especially if both surfaces are coated with white lead, glue or some such substance. In breaking this type of joint the gasket is usually destroyed, and it may require considerable scraping to remove all of the old gasket, but it is essential to have the surfaces clean in order to make a tight joint.

Hyattsville, Md. J. C. HAWKINS.

Another Lubricator Kink

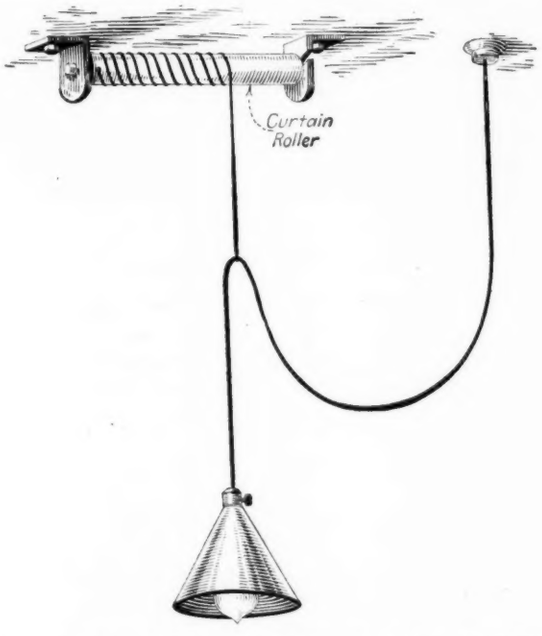
In the issue of Oct. 23, on page 571, I read the "Lubricator Kink," by C. H. Willey, and am sending one that I have found good.

Every time I fill a lubricator, I put in a small piece of white soap (any kind will do). The soap is a lubricant and will not hurt the cylinder or valves of the engine, but it will keep the drops of oil from sticking to the sight-feed glass and will clear the other glass as clean as if no cylinder oil had ever been inside of it.

Amherst, Mass. WALTER E. ROBINSON.

Adjustable Hanger for Lamp

I find no handier hanger for an electric lamp than that shown in the illustration. It consists of an old spring window-shade roller cut a suitable length and attached to the ceiling or other convenient support.



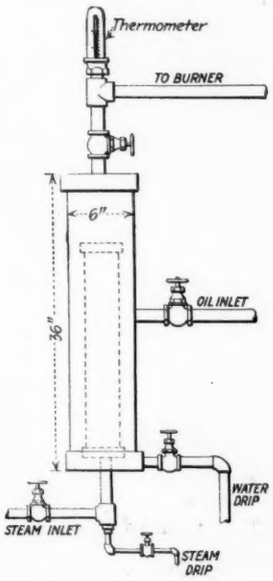
OLD WINDOW-SHADE ROLLER AS LAMP ADJUSTER

Wound around and attached to it is a stout cord for raising or lowering the lamp. A great number of modifications will suggest themselves when conditions demand a different arrangement. E. SCHWARTZ.

New York City.

Heater and Separator for Fuel Oil

Some years ago I was employed where oil was used in a number of kilns, and considerable trouble was caused by water in the oil, so that at certain times the fire was put out and our only warning was a strong smell of oil gas generated in the hot ovens. After connecting a separator and heater made as shown in the illustration into the feed line, all such trouble was overcome. The heater kept the oil at the proper temperature and also made it easier for the water to separate from the warm oil. The temperature of the oil can, of course, be regulated to anything within the capacity and requires little adjustment after being set for a given flow of oil. Since there is so much oil being used, this tip may interest someone.



CONSTRUCTION OF HEATER

Portsmouth, Ont., Can. JAMES E. NOBLE.

The Collapse of a Large Tank

A vertical oil tank, about 7 ft. in diameter and 30 ft. high, made of $\frac{1}{4}$-in. steel with $\frac{5}{16}$-in. heads dished in the regular way and the circumferential seams single- and the longitudinal seams double-riveted with $\frac{3}{4}$-in. rivets, had been hydraulically tested to 75 lb. in the shop. The tank leaked, however, when set up for service, and a boilermaker calked the seams; but having no facilities for testing the work with water or air pressure, the test was made with steam and "thereby hangs a tale." The steam was applied for the test and shut off but not relieved, and on returning to the work after an absence of an hour or so, the tank was found "collapsed flat."

Evidently the steam had condensed and reduced the pressure enough below that of the atmosphere so that the normal outside pressure had crushed the shell. The steam probably drove out the air, making the greater vacuum possible, there being no chance for air to reenter. This accident emphasizes the vital difference, always well to remember, between steam and air or water for testing boilers or tanks.

Scranton, Penn. F. WEBSTER BRADY.

Bedplates for Turbine Units

Commenting upon a letter which appeared in *Power* of July 31, page 162, and also in *Engineering* (London) Sept. 21, J. W. W. Drysdale, Jr., "Bon-Accord" Works, Yoker, Glasgow, W., writes as follows: I am much interested in the letter of N. L. Snow, of the Terry Steam Turbine Co., in connection with alignment of bedplates. The education of the public by manufacturers in a matter of this kind is a very slow business, and I consider that it would be time well spent if all the tech-

nical engineering schools were to devote a lecture or two each year to the principles and methods of alignment and the consequences to high-class machinery if the necessary precautions are neglected. I do not think it is fully realized, except by manufacturers of high-speed machinery, how much trouble is caused by bad alignment, and how much fine machinery is practically ruined or has its efficiency seriously impaired, by lack of knowledge on the part of erectors.

A curious point about the matter is that all erectors seem to be extremely "touchy" if one makes any suggestions in the matter of alignment. They seem to consider that the matter is one of the elementary things that it is ridiculous even to mention in their presence; yet, in spite of the most careful instructions and precautions on the part of my company, and the use of very heavy, deeply ribbed bedplates, it has been found that practically all mechanical troubles and undue wear are caused by jobs not being properly set up by the customers' erectors.

Another curious feature is the persistence of the idea that a set need not be carefully aligned if it has a flexible coupling. Nothing is more productive of harm than to have an erroneous idea of this kind widespread among erectors, as this undoubtedly is.

Accidents from Overspeed or Overpressure

I have read with much interest the two letters on page 464 in the issue of Oct. 2.

There is one characteristic that applies to turbines, as well as to reciprocating engines, in that there are many causes of derangement of governors or governor gears that are entirely out of the control of either operator or builder, but the speed of the turbine in most cases is so very close to the bursting point that accidents to turbine, even more than flywheel explosions, will continue to occur as long as they are not equipped with an efficient speed-limit and over-pressure-release device. Any governor is a delicately balanced affair and has to respond to slight changes, and it is quite apparent that anything that causes resistance to this movement is likely to cause a serious accident. In a turbine the possibilities of derangement are accentuated by the fact that the primary, secondary and emergency governor valves are the usual engineering compromise; that is, one feature is sacrificed for another to attain the main object, and the result is a construction that enchances the possibilities of sticking. The latitude required for efficient governing precludes the possibility of making the governor itself safe. It would be better to allow the designer an entirely free hand in designing a safety device, for the real reason that all these overspeed disasters have occurred has been that the emergency trip valve, which is supposed to trip from overspeed automatically or from a safely remote point by hand, has failed to operate. I have investigated many of these accidents, one of them being among those mentioned in Professor Trinks' letter, and found that in each case the trip valve had stuck and, had it operated, there would have been no accident.

Before these accidents can be prevented, it will be necessary to overcome the indifference of so many engineers to their auxiliaries, the type of purchaser who insists on purchasing the cheapest device, the purchaser or engineer who wants the best but lacks experience or knowledge of what constitutes a good device, and the purchaser or engineer who refuses to believe it is necessary to have such a device. Two things are necessary—a generous publicity of these accidents and an incorporation into the codes (state, A. S. M. E. and other authoritative bodies) of a clause setting forth what shall constitute an automatic closing valve when used for safety purposes—after a careful investigation and a series of tests of the different principles of operation. The only excuse for a turbine accident from overspeed or overpressure, or for a flywheel explosion at this date is either ignorance or parsimony.

C. H. CAMP,
The Strong, Carlisle & Hammond Co.
Cleveland, Ohio.

In regard to Professor Trink's letter, in which he questions *Power's* attitude in regard to turbine wrecks, I would say that I, too, wish reports of all turbine wrecks could be published, but Professor Trinks did not give *Power* credit for publishing in the issue of June 5 an article describing the disaster at the Hazelton plant of the Republic Iron and Steel Co., in which four men were killed and considerable damage was done while the turbine was new and the erectors were still on the job.

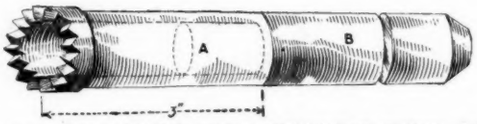
In one plant in which I worked, we had blade and bearing losses which were small wrecks in themselves, but all they meant to us was a lot of hard work; and as there was nothing awe-inspiring about them, they were not published, except in one case by a local newspaper and the description of the trouble was so distorted that we were the laughing stock of all the "wise ones" in town, so you can realize how we treated reporters after that.

I think the editor's answer a very good one, for it is surely a fact that in order for news of a wreck to leak out of a modern power plant, it must come through the walls in chunks, at the time, just as most engine wrecks did.

R. B. GOOLD.
Leadville, Colo.

Home-Made Wall-Drilling Tool

The figure shows a very successful tool made to drill holes in cement or brick walls for the passage of conduits, insulators, etc. A piece of seamless steel pipe is used for the cutter *A*. Small teeth are filed in one end, as shown, and then the tool is tempered a straw color.



WALL DRILL MADE FROM SEAMLESS STEEL PIPE

A shank *B* for driving purposes, made of machine steel, is inserted in the other end of the tool; the shank is made of a length suitable for the holes to be drilled. While driving, the cutter is turned around by hand; the material from the hole collects on the inside of the tool, which has to be occasionally emptied.

Ozone Park, N. Y. M. P. BERTRANDE.

Inquiries of General Interest

Admission of Live Steam to Receiver of Compound Pumping Engine—What is the purpose of admitting live steam to the receiver of a compound pumping engine that operates automatically to sustain the pressure of a variable pump discharge? S. K. L.

Most engines of the kind are controlled by a regulator which admits low-pressure steam to the receiver for supplying the low-pressure cylinder, so it may be of assistance in starting the pumping engine.

Connecting Returns from Different Buildings—What provision should be made for discharging the steam-heating returns from several buildings, all connected into the same return line discharged to a receiver? J. H.

As the returns of different buildings are likely to be at different pressures, each should be discharged into the return line through a separate discharge trap, with a trapped vent in the return line near each trap carried to a point where occasional escape of low-pressure steam from the vents would be unobjectionable.

Selecting Ratio of Bevel Wheels—The normal working speed of a vertical-shaft turbine waterwheel is 108 r.p.m. Where the power is to be transmitted to a horizontal shaft for belt transmission to a circular-saw mandrel with 22-in. receiving pulley and making 700 r.p.m., is the waterwheel any more likely to be stalled by the load with bevel-gear transmission in the ratio of 3 to 1, making the horizontal-shaft speed 324 r.p.m., than 2.33 to 1, making the shaft speed 252 r.p.m.? H. A. W.

The slower speed of horizontal shaft will entail slightly less loss of power from bevel-gear pressure and resulting friction, requiring a little less load at the saw mandrel to stall the waterwheel, but with ordinary proportions of bevel wheels the difference would be negligible.

Economy of Discharge Trap on Heating Apparatus—When a discharge trap is used for draining water from a steam-heating system, cannot more than the latent heat of evaporation of the steam be utilized? C. S.

If the condensate is discharged as fast as it is formed, the apparatus utilizes only the latent heat of evaporation or heat that was required to convert the water into steam after the water was raised to the temperature of the steam; and if the water is discharged at that temperature when the discharge takes place into a pressure equal to the pressure of the atmosphere, some of the water is converted into steam at atmospheric pressure, but most of the heat is retained in the water with its temperature reduced to 212 deg. F. The heat remaining in the water above the temperature of the feed water, less the losses incident to handling, can be recovered by returning the water to the boiler.

Damper vs. Ashpit Regulation of Draft—What is the advantage of regulating the draft of a boiler furnace by means of a stack or uptake damper as compared with regulating the opening of the ashpit doors? C. J. S.

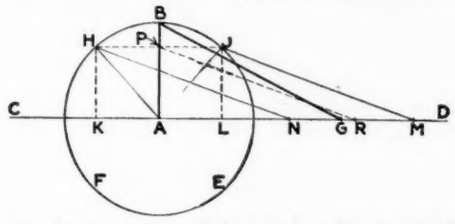
A stack damper admits of closer adjustment to the draft requirements and is more easily controlled by an automatic damper regulator operated by the boiler pressure. The main economic disadvantage in regulation of the draft by the ashpit doors is that when they are closed, or partly closed, for reducing the draft, the loss of heat from infiltration of air through the walls, cracks and joints of the boiler setting continues, and to a greater extent than when the ashpit doors are open. When the boiler is thus operated with part draft, the products of combustion move in narrower channels and are less uniformly distributed over the heating surfaces. With damper regulation, the draft being controlled at the final passage of the heated gases, infiltration of air is reduced by reduction of the draft, and when operating with part draft the furnace gases are banked and more uniformly brought into contact with the heating surfaces of the boiler.

Obtaining Temperature of Exhaust Steam—How is the temperature of exhaust steam of an engine determined? R. G.

The temperature of exhaust steam is the same as the temperature of dry-saturated steam of the same pressure unless, as rarely the case, the steam is superheated. The temperature can be determined from indication of an accurate thermometer placed in the exhaust pipe, or if the exhaust is not superheated the temperature of the steam may be assumed to be the temperature corresponding to the pressure of dry-saturated steam and may be obtained from steam tables such as those of Marks and Davis that have been ascertained by experiment. If a thermometer placed in exhaust or other steam shows higher temperature than the temperature given in the steam tables for dry-saturated steam of the given pressure, then the steam is superheatd and the number of degrees F. its temperature is above the tabulated temperature of dry-saturated steam of the given pressure would be "the degrees of superheat."

Relative Motion of Crank and Crosshead—If the crank of an engine is at right angles to the direction of the stroke, why will the crosshead be moved farther for a given angular motion of the crank when it is moved toward the crosshead than when moved away from the crosshead? R. O. M.

The relative crank and crosshead motion is more readily recognized by assuming employment of a short connecting-rod. In the figure, let AB represent the crank at right



angles with the direction of the stroke CD, let BEF be the crank circle, BG the connecting-rod, and G the center of the crosshead pin for the crankpin position B. If the arc BH is equal to the arc BJ, then with the center of the crankpin at H, its vertical height HK would be the same as the vertical height JL obtained with the center of the crankpin at J. With H and J as centers and radius equal to BG, the length of the connecting-rod, locate the positions of the crosshead pin; namely, at M for the crankpin position J and at N for the crankpin position H. Then the right-angle triangles HKN and JLM will be equal and HN will be parallel with JM. As the arcs BH and BJ are assumed to be equal, the chord HJ is bisected by AB at their point of intersection P, and if from P a line PR is drawn parallel to HN and JM, it will divide the parallelogram $HJMN$ into two equal parallelograms with $NR = RM$ and PR equal to the connecting-rod length $HN = JM = BG$. But with the connecting-rod extended from B the corresponding position of the crosshead center pin must fall short of the middle point R, because $PR = BG$ and B is higher than P. Hence as GM is more than half of NM it is greater than NG, which latter is less than half of NM.

[Correspondents sending us inquiries should sign their communications with full names and post office addresses. This is necessary to guarantee the good faith of the communications and for the inquiries to receive attention.—Editor.]

Great Britain's War Problems and How They Have Been Handled

Manufacturers, engineers, power-plant executives, engineering contractors, and other employers of labor who are readers of "Power" will find the addresses by Sir Stephenson Kent, K.C.B., member of the Council of the Ministry and director general of the Labor Supply Department; H. W. Garrod, deputy assistant secretary of the Labor Regulation Department; G. H. Baillie, chief technical dilution officer of the Labor Supply Department; and Capt. Cyril Asquith, director of the Artificer's Allocation of the Labor Supply Department, dealing with questions on labor supply, labor shortage, wages, and the substitution of women for men in munitions and allied industries of England, of exceptional interest. These gentlemen are members of the special mission of British Ministry of Munitions to the United States.

THE first three gentlemen addressed a representative body of American engineers at a dinner given in honor of the special mission by the United Engineering Society. The addresses of all four and a summary of the discussion as presented on the same day at a luncheon given in their honor by the Editorial Conference of the New York Business Publishers' Association have been reprinted by the McGraw-Hill Publishing Co., and the editors of *Power* will be glad to send to any reader interested a copy of the pamphlet containing these important contributions to the solution of our own labor problem.

Following are excerpts from the four addresses before the Editorial Conference of the New York Business Publishers' Association. Sir Stephenson Kent said, in part:

We recognized in England, after our first few months of very bitter experiences, that the organization of a nation's industries on a war basis is even more important than having an army. The army is as helpless as a baby in its cradle if there is not organization of the industries, and if the munitions that are absolutely vital to the success of that army are not forthcoming, and forthcoming without interruption. Continuity of supply and an ever-increasing supply are vital to the success of the army at the front. Industrial peace at home is a necessary accessory to the success of your army; without it, it is never going to dare to move.

My government called together, before the Ministry of Munitions existed, capital and labor—federations of employers and the heads, the executive chiefs, of our trade unions. That conference ended in what is known as the treasury agreement. That treasury agreement was embodied in the Munitions of War Act. The principal features in regard to that act are as follows:

In the first place, the Minister of Munitions definitely had power and definitely limited the profit made in any establishment that was engaged in the manufacture of munitions. In the second place, the wage of the labor in those controlled establishments was fixed.

The committee on production was set up, whose function it was to ascertain what, if any, the increased cost of living amounted to and to issue a national award in regard to that labor whose wage had been fixed, so as to meet the increased cost in the necessities of life that labor might find. That committee meets three times a year and has the necessary statistics laid before it, receives representations from trade unions and from anyone else who has a voice or should have a voice in the matter, investigates the case very carefully, then gives instructions that this labor should receive so much extra per week to meet that increased cost.

My government induced—it required very little inducement—the trade-union leaders in my country to agree to waive all the restrictive practices that had been common in the manufacture, on the civil side (what now is the munition side), from the point of view of output or of engagement of labor on war work, for the period of the war. On the government's side, it pledged itself to restore the pre-war conditions in any factory where by that agreement the normal conditions had been varied.

We take the view that today, above all other times, it is absolutely vital to exercise economy from every point of view—economy from the point of view of food—yes; but economy from the point of view of the materials that are essential to the winning of this war; economy from the point of view of the use of man power. We look upon it today in England as a very serious crime if steel or copper or lead or iron or any of these raw materials of which we never had a sufficiency is used for any purpose other than to help to win the war. We look upon the misuse by an employer or the army or a government department of the skill of any mechanic or any citizen as really a mistake and a crime and something that it is our duty to put right.

It is absolutely impossible to exaggerate the importance, the overwhelming importance, that labor plays in war. Without labor, without that industrial peace of which I spoke, this war cannot be won. It is the basis of the war. Your man power at the front, your man power at home, all turns on labor's activities and the solution of the problems that war brings in regard to labor.

I want to say this also: That on the solution, on your solution, of the problems with which you are faced, a great deal depends in my country, too. Should you fail to solve those problems, it will react, and react very seriously, in England; and we look to you with a great deal of confidence. I think we appreciate how enormous those problems are, but we are very happy that you will solve them, and solve them on the right lines.

How Shortage of Skilled Labor Was Met

G. H. Baillie, in explaining how the shortage of skilled labor was met in England, said, in part:

Our two schemes have been the dilution of skilled labor and the substitution of women for men. First, an unskilled worker was brought into the plant to do an easy job. The man so displaced was put on the more skilled work, and the man displaced was again promoted, and so on until there had been an upgrading of skill throughout the whole shop.

Another method adopted was to draw unskilled men from the nonessential trades—unskilled men who were either over military age or of low medical category. Watchmakers were brought into the toolrooms to do gage making. Our building industry was largely closed down, and we took sanitary plumbers from there and trained them up to do lathe turning for our explosives factories. We also drew from the building industry carpenters and joiners and sent them into the shipyards to act as shipwrights and shipjoiners.

We took mechanics, textile mechanics, from the textile industries, accustomed only to rough work, and trained them up to the better work of munitions. A third way was by confining the fully qualified mechanic to the highest forms of skilled work. If the mechanic normally had been on a job that could be split up into two or more parts of varying degrees of skill, the mechanic was confined to the part requiring the most skill, and we trained up men and women to do the less skilled parts.

Those schemes we called the "dilution of skilled labor," because we made the very little skill we possess go a very long way by diluting it with as much unskilled labor as possible.

But this method fell far short of producing enough workmen, so women were employed.

Mr. Baillie outlined several classes of unskilled work successfuly done by women, mentioning that in many lines of work 90 per cent. was performed by them.

H. W. Garrod, in commenting upon the labor disputes they had in England, said, in part:

We have had only three labor disputes since the war began which could be called serious. One of those lasted, I think, ten days, and neither of the other two lasted as much as a week. They were serious to us. They might not be thought serious elsewhere.

In summing up his observations of labor conditions in this country, Mr. Garrod said:

I will just add one other word, if I may, which I hope won't be taken as being anything in the nature of advice or criticism. Since we have been in this country, a period now of nearly ten weeks, we have been witnesses from a distance of a very considerable number of trade disputes, which have been, so far as we could judge, serious and in some cases prolonged. But what I want to say is that if one-eighth—I think that is no exaggeration—of the industrial troubles which we have witnessed in this country in the last two months had taken place in England over the whole period of the last two years, we should long ago have been compelled in England to sue for disgraceful peace. That, I think, gentlemen, is a serious and solemnizing reflection, and I want to leave it to you without comment.

Capt. Cyril Asquith, speaking of the labor-supply department in England, said:

Artificer is a name we have in the army for skilled men. It is nothing more or less than a skilled machinist. I think it would probably surprise you to know how large those demands are. The technical branches of the army—that is to say, like the Army Corps, Royal Flying Corps, Royal Engineers, and so on and so forth—compose altogether about half the total number of the armies. I don't say those corps consist wholly of skilled men, but they are filled with them to a greater or to a lesser extent.

Just to give you some notion of the magnitude of the demands which they make, I may mention that as we left England a demand was presented by the War Office for 40,000 skilled men to work on the railways behind the lines in France, and that about three or four weeks ago we heard that a further demand for 15,000 highly skilled machinists had been presented.

We are embarrassed in our attempts to meet those demands by the fact that, in common with practically every other European power, we made the mistake in the first year of the war of permitting the enlistment in infantry and other regiments of highly skilled machinists who would have been much better employed either in civil life upon munitions or in these technical branches of the army to which I refer.

We look to you, gentlemen, to avoid that mistake, and we look to you with the utmost confidence. In fact, we know already that your War Department has taken steps to avoid it. It is about the only mistake we think you should avoid. We have been immensely impressed in the course of our tour with the enormous reservoir of ability and energy and resource which America contains. It gives us high hopes of a certain and not-far-distant victory.

The Refrigerating Power Plant as a Fire Risk*

Thirty-seven per cent. of the fires in refrigerated warehouses have their origin in the power plant, 22 per cent. starting in the engine room and 15 per cent. in the boiler room.

A summary of the fire record of cold-storage warehouses collected by the National Fire Protection Association is given herewith.

LOCATION OF FIRES (WHERE STARTING)

	Per Cent.
Storage sections	25
Engine-room and refrigerating apparatus	22.5
Boiler rooms	15.0
All other rooms	12.5
Outside (exposure, etc.)	12.5
No data	12.5
	100.0

Twenty-five per cent. of the fires start in cold-storage rooms. The suggestions herein offered for isolating these rooms for storage uses only, if adopted, will lessen this high percentage materially. The presence of motors and other power apparatus, of smoking, and the use of the rooms for other than storage purposes, are factors causing many of the fires. Many of them are from unknown causes.

The inaccessibility of these rooms and the large values which they contain result, usually, in great losses. The arrangement and construction of these sections is most important.

The 22 per cent. starting in the engine room and refrigerating apparatus shows the need of the more careful safeguarding of the machinery. This, together with the 15 per cent. of fires starting in the boiler rooms, gives a total of about 38 per cent. of the fires originating in the power plant, and these are mostly from common and easily removable causes.

KNOWN CAUSES OF FIRE

(The exact cause of 30 per cent. of all the fires is unknown.)

	Per Cent.
Boiler, boiler flue, etc	22
Ventilating fans	14
Explosion	11
Refrigerating machinery	11
Heating apparatus	11
Incendiary	7
Miscellaneous (sawdust insulation, smoking, power, egg candling and repair work)	24

*From suggestions prepared by the Committee on Manufacturing Risks and Special Hazards, National Fire Protection Association.

The large percentage of boiler fires in this class of property is practically all avoidable. Better housing of the boilers, better care of waste matter to be burned and better construction and arrangement of breeching, flues and stacks will reduce the losses materially.

The safety of the power plant is vital to a cold-storage warehouse. The refrigerating machinery must be of the best and safely housed. It is the heart of the plant and the life of the business. A fire here, interfering with the operation of the refrigerating machinery, might result in a serious loss to the contents on account of the destruction of means for maintaining the necessary temperatures.

The power plant should preferably be in a detached fireproof one-story building with the refrigerating pipes to the main building underground or in a tunnel. If not detached, the power plant can be cut off from the main building by a standard parapeted brick fire wall without openings. Pipes passing through this wall should be under the floor or near the floor and the pipe holes closely cemented up. Sleeves can be inserted, packed with asbestos or mineral wool between the sleeve and the pipe where movement from expansion and contraction of the pipe is expected.

Avoid exposed steel in constructing the power plant. Light unprotected steel trusses supporting the roof are objectionable. Columns, if of steel, should be well fireproofed. If steel trusses or girders must be used, they should be insulated.

The construction of a combustible power building for a cold-storage plant is most unwise as the entire business is subject to ruin from the fire hazard of such a plant.

The boiler room should be cut off from the engine room by a standard fire wall, with openings, if any, protected by standard automatic fire-doors.

If the boilers supply steam for a fire pump, there should be no inside doorways into the engine room, the walls being blank. Ammonia fumes entering the boiler room would be apt to make it impossible for men to stay on duty to fire the boilers as is necessary to run a steam fire pump. There is always more or less danger of a break or explosion in the refrigeration machinery, and this danger should be safely guarded.

The boiler house and its furnishings should be entirely noncombustible. If a wooden roof is necessary, keep it and all woodwork at least four feet away from the smoke flue and breeching.

A recent fire occurred where a flue six feet away ignited a wooden ceiling. If a four-foot clearance cannot be maintained, cover the flue with insulating lagging two to six

inches thick according to the conditions. It is better for this purpose to insulate the flue than to cover the ceiling with metal, as the metal may transmit the heat and ignite the woodwork to which it is fastened.

There should be at least two separate sets of refrigerating machinery in order that the service can be maintained when repairs are necessary. This demands a duplicate set of discharge and return pipes leading from the engine room; with controlling valves located outside or in a separate cutoff valve room so they could be operated if the engine room became uninhabitable from ammonia gas.

The indirect or brine circulation system is safer than the direct expansion system as all high-pressure and ammonia pipes are kept out of the storage rooms, eliminating the danger of firemen being overcome by ammonia vapors. It may be necessary, where extremely low temperatures must be maintained, to use the direct expansion system. If so, these pipes should run directly from the engine room to the freezers and be kept out of all other rooms. The freezers should preferably be located in a fire section by themselves. Systems where the air is circulated by large fans are objectionable.

The absorption system should be used where it is adaptable to the work. It is considered the safest system.

Only a modern ammonia system should be used, avoiding such inflammable refrigerating agents as ether and ethyl chloride and such a poisonous one as sulphur dioxide.

Carbon dioxide as a refrigerating medium is not considered dangerous, but the high pressures necessary to its use tend to cause breaks in the apparatus and to an increased vaporization of oil. The same safeguards are advised as for ammonia systems.

Although ammonia gas is presumed to be nonexplosive, many explosions have occurred in ammonia compressors and the apparatus connected with them, probably due to the presence within the system of oils used in lubricating the compressor. The so-called "wet system," where oil is drawn into the cylinder with each stroke, is considered objectionable. In some cases several barrels of oil have been taken from systems of this kind when they were cleaned out.

Cylinder Relief Valves Should Be Provided

The clearance in a compressor cylinder is slight, and the accumulation of oil or water is apt to break out the cylinder head, liberating the inflammable vaporized oil. The heat of the cylinder is often sufficient to vaporize the oil, and even some ammonia gas more or less mixed with oil vapor may be liberated that is readily combustible. Relief valves should be provided on the cylinders of all compressors to care for excessive pressures resulting from accumulations of oil or water.

The presence of volatile hydro-carbons in the ammonia which cannot be liquefied in the condenser results in high pressures and is a source of danger. The purity and "dryness" of the ammonia are important. The discovery of these foreign gases in a system is difficult but their elimination is necessary both for safety and efficiency.

It is important that an ample water-circulation system be provided to keep the cylinder temperature as little in excess of 200 deg. as possible. It is thought that the oil vapor in some cases may have been ignited by the high temperature of the cylinders.

Owing to the possibility of igniting oily vapor from the apparatus, no open flames should be permitted in the engine room and the incandescent electric lamps should be well protected by heavy wire guards.

The presence of air within refrigerating apparatus is objectionable from the viewpoints of safety and economy of operation. It undoubtedly has been an aid in the formation of explosive vapors. Means should be provided at several places on the apparatus for the removal of entrapped air, and it should be removed regularly.

Air has been found to enter the pipes through defective gaskets. Only metal gaskets and packings should be used.

Another source of danger arises from testing by air pressure old ammonia systems or systems that have been extended or repaired. Air pressures used for this purpose should not exceed 100 lb. Every effort should be made after the test to remove all air from the system.

To avoid the accumulation of ammonia, in case of breakage of the pipes, where likely to handicap the work of firemen and endanger life, a cutoff valve arranged to operate automatically in case of a sudden reduction in pressure should be placed on the discharge pipes of the compressors. These valves, in operating, should divert the gas to out-of-doors.

An oil remover and regenerator is essential to the safety and economy of a system. It pays to recover the ammonia contained in the oil. This is done by heating. In some cases the oil hazard may be eliminated by using lubricants made of graphite, but this is material not suitable to all conditions.

The use of gage-glasses on the apparatus in the storage sections is objectionable and they should be prohibited. Their breakage not only releases the ammonia, making fire fighting difficult, but in many instances has resulted in fire by discharging inflammable vapors. Where absolutely necessary, whether on pipes or oil receivers, gage-glasses should be provided with automatic shutoffs.

In the engine room and elsewhere, if they must be used, gage-glasses should be protected by automatic ball checks.

Refrigerating machinery should be under the care of reliable men. An explosion may be brought about in a most modern plant by the careless manipulation of the regulating or "expansion" valve. A surplus of liquid cannot be allowed to return to the compressor without danger of accident.

Tanks of ammonia should be stored in a cool place and one where a fire is unlikely. If expanded by severe heat, the gas might rupture the tanks.

The following examples of fires originating in refrigerating apparatus are typical:

Case 1: A pipe connection between the analyzer and the rectifier of an absorption system broke following which after about five minutes an explosion blew out some windows of the building. An open forge on another floor is thought to have ignited the gas. Fire followed.

Case 2: A cylinder head in a compression system blew off. No fire ensued.

Case 3: A cylinder head in a compressor blew out. Open gas jets ignited the vapor and an explosion resulted.

Case 4: A similar accident to Case 3, in the same plant but in another compressor. Explosion and fire resulted in destruction of all combustible parts of the building.

Case 5: Gage-glass in oil reservoir broke, releasing oil and ammonia gas. Fire ensued. Vapors thought to have become ignited from the commutator of the dynamo.

Case 6: Four bypass valves on a compressor broke, releasing ammonia and oily vapor. In three to five minutes an explosion occurred. Vapors thought to be ignited by arc lamp.

Case 7: An oil separator exploded, system being tested under air pressure. Vapor ignited in some unknown manner.

Meeting of New York Section, American Society Refrigerating Engineers

The New York Section of the American Society of Refrigerating Engineers held its third meeting at the Machinery Club, 50 Church St., New York City, Monday evening, Nov. 12, 1917. Thirteen members and sixteen guests attended; President John E. Starr's ill health again prevented him from being present. First Vice President L. Howard Jenks acted as chairman.

After the usual one-dollar subscription dinner had been enjoyed, Chairman Jenks asked Charles Dickerman, Jr., to present his paper on "Heat Transfer in Refrigerating Apparatus." Mr. Dickerman's paper is a welcome continuation of the paper, "Heat Transfer from Air to Pipes," by Charles H. Herter, read at the meeting of Sept. 27, and contains a number of constants that have not been given previously. Both of these papers on heat transfer are scheduled for the A. S. R. E. *Journal* for November, 1917. Mr. Dickerman studied the rate of heat transfer from air to bare pipes, air to frosted pipes, heat flow from water in ice can through ice, and galvanized steel to surrounding brine. He showed how existing theoretical data were verified by results of

practice and borne out by his own tests. Among the coefficients of heat transfer k given by Mr. Dickerman in B.t.u. per hour per square foot per degree mean temperature difference, the following may be mentioned:

With ordinary submerged type of Ammonia condenser	k = 30 to 37 B.t.u.
With freezing-tank coils, Dry feed system	13.5 B.t.u.
Flooded system	20 B.t.u.
The rating of some flooded-injector type of ammonia condensers figures out	236 B.t.u.
Considering usual unfavorable operating conditions	140 B.t.u.
The rating of strictly counter-current atmospheric ammonia condensers is based on	125 B.t.u.
Yet values of k = 150 are realized in everyday operation. With parallel-flow atmospheric ammonia condensers (hot gas entering at the top), k is only	62 B.t.u.
In overflow-type milk coolers, where milk is cooled by water in the upper section and cooled by ammonia in the lower section, k in both sections is about	75 B.t.u.
The temperature range in the upper section (1¼-inch pipe) is in the case referred to, 12 deg. F., and in the lower section (2-in. pipe), 41 deg. F. For small direct-expansion milk coolers k equals	80 B.t.u.
For large coolers (greater rate of flow of milk) k equals	50 to 60 B.t.u.
Cream coolers require 20 per cent. more surface. In direct expansion overflow type oil coolers, cooling thick quenching oil, k proved to be only	10 B.t.u.
With horizontal shell-and-tube brine coolers, using ammonia, k equals	98 B.t.u.
Heat flow a, metal to liquid, each side of galvanized ice can, equals	89 B.t.u.
Internal heat conductivity c of ice, 15.9 B.t.u. per hour per square foot 1 in. thick, per degree F. difference, and less, depending upon density, Mr. Dickerman, adopts	
Heat flow a, air to ice, average	1.46 B.t.u.
Air to wet glass	2.39 B.t.u.
Air to dry surfaces	1.3 B.t.u.
For brine pipe to unagitated air, k equals	2.16 B.t.u.
For dry, direct expansion pipe to unagitated air, k equals	1.7 B.t.u.
One-inch layer of hard ice reduces refrigerating capacity of lineal foot of pipe to 81 per cent. of 2.16, or to k = 1.75. One-inch layer of soft ice (with c = 7.5 B.t.u.) reduces this to k per square foot of external pipe surface, equals	1.60 B.t.u.
One ton of water per 24 hours = 10 gals. per hour = ⅙ gal. per minute.	

Henry Torrance pointed out that at the December, 1917, meeting, he would prove that the value of k was no higher in flooded condensers than in the ordinary type. Fred Ophuls contended that in a condenser stand doing 25 tons refrigeration, the value of k must be higher than in a stand doing but 12½ tons of work, because both mediums are moving at higher velocity.

One of the most interesting points brought out by Mr. Dickerman was the advantage to be derived from freezing 300-lb. blocks of ice in cans averaging 10 in. instead of 11¼ in. Leaving the cans 22¼ in. in the other dimension, as at present, only 6 in. would have to be added to the height of tank; the 10-in. cans would permit of using more cans across the width of tank. Considering the greater number of cans available and the saving effected in freezing time, the output of a freezing tank of given size could be increased by as much as 50 per cent. simply by making the blocks slightly thinner. Some members thought this a capital suggestion, while others, including Theodore O. Vilter, L. H. Jenks and C. R. Neeson, were afraid the ice trade would oppose such a change, except possibly in the case of ice plants intended for foreign countries. There no such prejudice would be encountered, and there the thin cans could be introduced.

A vote of thanks was extended to Mr. Dickerman for his paper.

A deficit of seven dollars created by the nonappearance of seven members for whom dinner had been reserved was covered by donations made by Chairman Jenks and Messrs. Torrance, Ophuls and Vilter.

The suggestions for desirable papers offered at the Sept. 27 meeting were then gone over with the object of finding men to write these papers. The subject, "Cooling Tower with City Water vs. Use of Sea Water for Condensing," was assigned to B. H. Coffey and H. H. C. Lasker. Harry B. Joyce, power engineer of the United Electric Light and Power Co., New York, was encouraged to discuss "Central Station vs. Isolated Plant."

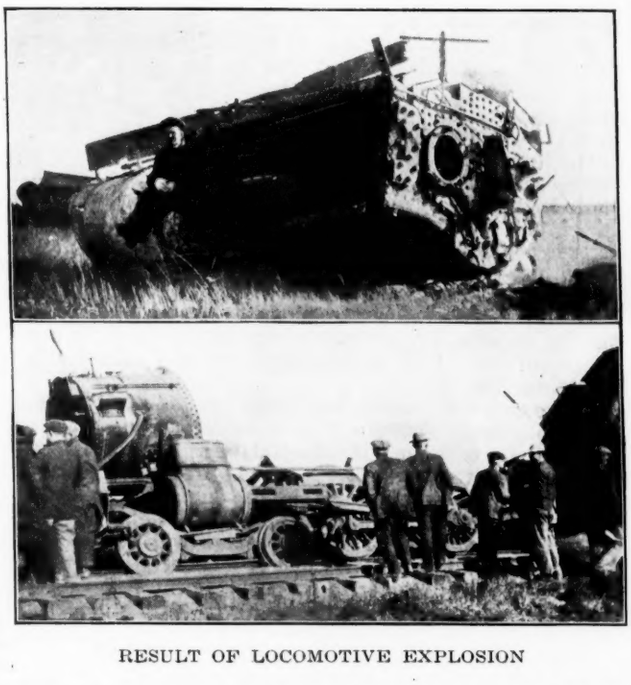
C. R. Neeson and C. H. Herter suggested to let outside engineering specialists connected with prominent manufacturers, such as electrical and pneumatic engineers, come before the New York Section to deliver instructive lectures. This was acquiesced in, provided all advertising was omitted. Mr. Neeson volunteered to secure a paper on "Synchronous Electric Motors for Operating Ammonia Compressors" from an engineer of the Electric Machinery Co., Minneapolis. Adolph G. Koenig agreed to prepare a paper on "Brine-Spray System for Refrigerated Meat." John L. Plock offered to prepare a paper on "Preventable Losses in Steam Generation."

The date of the next regular meeting was fixed for Jan. 15, 1918.

The secretary's third suggestion, expressing the decided preference of a few members living remote from the city to meet at 3 p.m. instead of in the evening received no support.

North Western Locomotive Explodes

The two photog-aphs shown herewith were taken about two hours after the boiler of a North Western west-bound freight locomotive exploded, Nov. 12, about four miles east of Gordon, Neb. The train was an extra freight and was running slowly at the time. The boiler was blown about one hundred yards almost straight ahead, struck the ground



RESULT OF LOCOMOTIVE EXPLOSION

head-on a few feet from the track and turned over endwise with the fire-door to the west. The driving trucks were left on the roadbed. In the upper illustration a man is shown sitting on the edge of the crown-sheet, the failure of which caused the explosion, where it was torn from the side sheet. The engineer was found some distance from the track, on the right-hand side, and the fireman was between two of the left driving wheels. Both were seriously injured, but are expected to recover.

Opening Meeting Chicago Section A.S.M.E. a Great Success

On Friday evening, Nov. 16, the Chicago Section of the American Society of Mechanical Engineers held one of the best-attended and most enthusiastic meetings since its inception. An innovation highly appreciated by local members was the attendance of the council. Outside of spring meetings this is the first time the council has met away from headquarters in New York. Their reception was enthusiastic and will no doubt lead to similar visits to other local sections of the organization. Each member had a brief message to impart.

A. D. Bailey, chairman of the section, first called upon Charles T. Main, of Boston, who spoke of coöperation among the various engineering associations of his home city. He said the results had been three joint meetings per

year, an annual dinner and the Engineers' Club, to which all classes of engineers belonged. He stood for coöperation among all engineers and favored activity in the sections.

Max Foltz, of St. Paul, now a major at Camp Dodge, Des Moines, Iowa, referred briefly to the rapid development of the troops and the greatest spectacle in camp life, the Retreat. It was his opinion that the more done for the sections the better the society will be.

Past President Goss expressed the view that it was not what you could get out of the society, but what you could contribute to it and to the engineering profession that really counted. It was a case of each contributing to the cause and working in coöperation with others.

Dean Richards, of Illinois, said that it was the time of all times to get together to promote engineering as a whole. The Committee on Sections was actively engaged in distributing propaganda for coöperation. In Chicago there was unusual opportunity in this direction. There was no reason why in time there should not be a headquarters, with an engineering building second only to general headquarters in New York.

John A. Stevens, chairman of the Boiler Code Committee, talked of standardization. It was an American idea which had found many applications resulting in the saving of time, material and labor. Through it, he said, we would gain the world's trade and by it we would hold this trade.

Ira N. Hollis, president of the society, made a final plea for coöperation and told what it would mean for this country. Briefly, he reviewed the character of preceding centuries, and it was his prayer that the bloody and barbaric records of the first part of the Twentieth Century would be wiped out by the united and unselfish efforts of engineers to better mankind. He said it was the plain duty of the engineer, who knows most about war, to save his country and the sciences, and his task to make the present the greatest century of all by the establishment of a universal and permanent peace.

Fuel conservation offers immediate opportunity for action. The public needs instruction on methods of saving coal and the necessity of saving it. For this work nobody is better qualified than the engineer. With the proper authorities at Washington, the speaker said, he had already arranged for a definite coöperative body of consulting engineers to act under the Bureau of Mines. Speakers will be needed to lecture all over the country, and if engineers do not come forward, making it plain to the Government that they are the proper men to do the talking, they will not deserve to be classed as belonging to a learned profession.

Maj. Peter Junkersfeld, formerly with the Commonwealth Edison Co., of Chicago, was the speaker of the evening, his topic being "Cantonment Construction." In his capacity as officer in charge of inspection, he had had exceptional opportunity to gather information and presented a most instructive paper. He told how sixteen cities (for each cantonment is a city in itself, containing 1000 to 1200 buildings, a water-works, sewage system, etc.) had been built from the ground up between June and October. It was an immense task requiring 450 million board feet of lumber, immense quantities of piping, sewage tile and other supplies and thousands of laborers.

In the construction of the sixteen original cantonments, the cost per cantonment averaged $8,000,000, or $200 per man. The contracts were let on the cost plus fixed profit basis, the terms being 10 per cent. on the first $100,000, 8 per cent. on the next $100,000, 6 per cent. on the third $100,000, etc., with a limiting or maximum profit of $250,000. The total expenditures at each cantonment run into such large figures that the limiting profit became active, so that the average profit to the contractor amounted to only 3 per cent.

There are still quarters to be built for the National Guard, immense warehouses to store the supplies for France, embarking stations and other work. Contrary to the general belief, the speaker said, the work has been done efficiently considering the conditions and the speed required. There has been no unnecessary waste. The work has been carried on by four principal divisions: Engineering, material, finance and construction, under Col. T. W. Littell, head of the Cantonment Department.

Courses in Naval Architecture and Marine Engineering

The Polytechnic Institute, College of Engineering, Brooklyn, N. Y., announces that it recently opened evening courses in naval architecture and marine engineering. The course is to meet the needs of the United States, which has entered upon a shipbuilding policy that will make it the greatest shipbuilding nation in the world.

The following is an outline of the course in naval architecture:

1. Ship terms and nomenclature. Classification of societies and their connection with shipbuilding. Ship calculations and the rules used.

2. Method of ship construction, including the ordering of the material by the drawing office, mold loft work, templets, bending, slab and erection of the structure.

3. Ship design—Conditions of service that must be known, including routes and ports of call, carrying capacity, draft allowed, speed required, accommodations, etc.

Ship lines—Their construction, their place in the building, and the conditions they must fulfill.

Ship plans for the classification societies—Midship section and profile.

Ship plans for the owners before the contract is awarded —General arrangement and profile.

Working plans as gotten up in the office, including the model, shell expansion, bulkheads, decks, framing, etc.

4. Ship estimating, including weights, powering, displacement, centers, etc.

5. Ship calculations, including displacement, stability, strength, capacity, launching, inclining to determine center of gravity, etc.

The fee for this course is $20. The student must have descriptive geometry and the mechanics of materials.

The course in marine engineering consists of 15 lectures, with drafting, on Wednesdays, 6:30 to 9:30 p.m., and began Nov. 14 under the direction of Daniel D. Gardner, with the Federal Shipbuilding Co., of New York. An outline of the course is as follows:

1. Boilers—Lectures and drawing. Determination of size. Working drawing. Ordering material. Plates, tubes, stays and rivets.

2. Engines—Lectures and textbook work. Determination of cylinder sizes. Design of engine parts and their strength calculations. Engine balancing. Turning and reversing engines.

3. Air pump and condenser—Lectures and textbook work. The accepted method of computing condensing surface, including all the calculations necessary for the actual design of the air pump and condenser.

The fee for the course is $20.

The aim of the courses is to give the students such a comprehensive training that, when they enter a shipyard or a ship drawing office, they will understand what is wanted of them and how to proceed in accomplishing it. The advantageous location of the Institute at the most important seaport in the world is pointed out. A. Mathies, who will conduct the course in marine engineering, is a graduate of the University of Michigan, has had several years' experience in the design and construction of ships, and has been connected with the New York Shipbuilding and Dry Dock Co. and the Canadian Vickers Co. He is at present with the Federal Shipbuilding Co., of New York.

For further information apply to Charles A. Green, Director Evening Department, 85 Livingston St., Brooklyn, N. Y.

Commercial Attaché C. W. A. Veditz, Paris, reports that the monthly production of coal in France has increased from 1,576,062 tons in June, 1916, to 2,345,251 tons in June, 1917, the output of the French coal mines having increased almost steadily during the intervening period. The increase in the output has continued since June, 1917, at which time the total French production, added to the imports of British coal, reached a total of over 3,960,000 tons. French production and British imports in August, 1917, amounted to 4,346,000 tons.

Jobbers' Coal-Price Rule Modified

Large quantities of coal will be made available for the country's immediate fuel supply under an order issued by Fuel Administrator Garfield authorizing state fuel administrators to permit the sale of coal held under contract by jobbers and wholesalers at the contract price plus the jobbers' margin as fixed by the President.

Under previous orders coal contracted for by jobbers could be sold only at the prices fixed by the President. A large quantity of this coal had been contracted for by jobbers and wholesalers prior to the President's order at considerably above the fixed prices. Unable to sell at a price equivalent to the cost to them, the jobbers have continued to hold their coal.

To take advantage of the new order jobbers must prove that their high-priced coal was contracted for under bona fide agreements prior to the President's proclamation. They must accept a price equivalent to their contract purchase price plus the fixed 15 per cent. margin allowed jobbers under the price-fixing proclamation. They must sell their coal to purchasers designated by the state fuel administrators.

The order will place at the disposal of the state administrators a large quantity of coal which may be distributed to relieve communities where a shortage has developed.

The World Do Move

Public opinion is responsible for much of the success of our efforts. A broker told me that in two years he had made $400,000 by reselling contracts within an organization of which he is a member. This was once considered good business, and that man was hailed as being smart. Now, if this course of action were pursued, that man would be held up as an enemy to his country. There is no reason why people should go hungry to permit one man to turn over contracts and make $400,000. Public opinion is completely changed, and now looks upon any such project as a detriment to the country.—*Arthur Williams.*

Service Overseas

The following skilled men are wanted by the Enlisted Ordnance Corps, National Army, for early service overseas. The men in the front-line trench need the help and coöperation of men back of the lines.

Uncle Sam is calling on all trades to come across and help his fighting men. There is a lot of work to be done over there, and the call has gone out for operating engineers *of all kinds*, firemen, water tenders, oilers, pipefitters, blacksmiths, electricians, linemen, wiremen, electric machinists, general machinists, marine and locomotive engineers; in fact, all skilled tradesmen between the ages of 18 and 40 who want to do their bit and who know their job.

Modern war is a tremendous business, and the army that wins is the army which has the best equipment and the best men. The men are over there now—they are ready to go ahead, but they still need experts in our line to repair and maintain their equipment. There is a fine chance for every man who wants to help. Write to the Chief of Ordnance, War Department, Washington, D. C.

Fuel Administrator Garfield is sending a letter to all of the state fuel administrators on the methods of handling exorbitant retail coal prices. He suggests that the local committees make careful investigation of the costs of doing business by each dealer and, if it appears that more than a reasonable profit is being exacted, that the committee send its recommendation as to a reasonable price or prices to the state administrator, who will determine whether such price or prices are equitable to both the consumer and the retailer. The state administrator will then confirm such price or prices in that town or city, subject to appeal to the United States Fuel Administrator. Careful investigation is advised, and it is recommended that the profit allowed be based on flat value rather than percentage, as the latter would give the less efficient dealer with higher costs a larger actual profit than the more efficient dealer with lower costs.

Engineering Affairs

The Power Test Committee of the American Society of Mechanical Engineers will hold a public hearing upon the rules for conducting tests of boiler-plant apparatus at the Engineering Societies Building, 29 West 39th St., New York, on Friday, Dec. 7. The hearing will be attended by the recently appointed advisory committee.

The Combined Engineers' Association of the N. A. S. E., of Brooklyn, N. Y., held its tenth annual entertainment and reception at the Arcadia on Saturday, Nov. 17. There was the usual big attendance, including delegations from New York and New Jersey. Dancing was the leading feature. Interspersed between the dances there was an entertainment of eight novelty numbers, which was thoroughly enjoyed. The officers of the combination are: Charles Schabacher, chairman; George Lewis, vice chairman; Walter F. Brundage, secretary; John P. Martin, financial secretary; George O. Kaley, treasurer; Charles Baxter, sergeant-at-arms.

Business Items

The McIntosh & Seymour Corporation announces that owing to the present great demand for marine equipment, it has decided to close its St. Louis office temporarily and transfer C. G. Cox, the present central district manager, to the Pacific coast, with headquarters at San Francisco and Portland.

The Sanford Riley Stoker Co., Ltd., of Worcester, Mass., has had such an increased volume of business in the Riley underfeed stoker that it has arranged for additional manufacturing facilities in Detroit, Mich., at the plant of the Murphy Iron Works. There will be no change in the management or policy of the Murphy Iron Works. They will continue the manufacture of the Murphy automatic furnace, increasing their manufacturing facilities as required for the production of Riley stokers. R. Sanford Riley, of Worcester, Mass., has been elected president of the Murphy Iron Works. The B. F. Sturtevant Co., of Hyde Park, Mass., will continue to manufacture and act as selling agents for the Sanford Riley Stoker Company.

Miscellaneous News

Fuel Administrator Garfield has ordered that "hereafter consignments of coal shall be made on the basis of a fixed price, not subject to revision on account of any subsequent regulation of price by the United States Government."

The Bronx Union Branch, Y. M. C. A., has added to its program a school of heating and ventilating. The course comprises twelve Wednesday evening lectures, the first one on Dec. 5. The lectures will cover heating and ventilating, with special reference to computation of heating surfaces, pipe sizes, boilers, etc., for gravity and vacuum steam systems, for gravity and forced hot-water systems; sizes of ducts, fans and heaters for various kinds of ventilating systems, purification of air, refrigerating and humidifying devices. No particular requirements as to education and mathematics are necessary. The course is of special importance to those who are employed in plumbing and heating contractors' offices and to superintendents of buildings. Charles A. Fuller, a consulting engineer with Clark, MacMullen & Riley, will conduct the course. Further particulars may be obtained by addressing Bronx Union Branch, Y. M. C. A., Educational Department, 161st St. and Washington Ave., New York City.

Power Plant Economy Committee—David Whitcomb, Federal Fuel Administrator for the State of Washington, has appointed the following committee, to be known as the "Power Plant Economy Committee," for ascertaining methods of conserving fuel in power plants and the education of power-plant owners and their engineers and firemen in these methods: A. S. Downey, chairman; W. N. McBriar, chief engineer of the Carnation Milk Products Co.; H. W. Beecher, manager of C. C. Moore & Co., and H. H. Botten, of the Washington Surveying and Rating Bureau. The business of the committee will be the investigation of up-to-date methods of firing, to encourage the manufacturer to take a keener interest in his fuel consumption and to back up his fireman by giving him the best information and equipment obtainable, and to show him how present equipment can be used to the best advantage. The demand for coal far exceeds the supply, and any saving in the power plants, which consume 10 per cent. of the coal of the state, will approximate a large figure.

Personals

W. C. Kammerer, formerly mechanical engineer with the Texas Co., at Port Arthur, Tex., is now with the National Carbon Co., at Cleveland, Ohio.

J. B. Laird, until recently connected with the Moore Steam Turbine Corp., Wellsville, N. Y., has resigned his position with that concern to go into the machine-tool business.

Prof. Frederick L. Pryor is now dean of the senior class of the department of electrical engineering, Stevens Institute, Hoboken, N. J., in the vacancy caused by the death of Prof. Albert F. Ganz.

Louis A. Hazeltine, formerly assistant professor of electrical engineering at Stevens Institute of Technology, Hoboken, N. J., is now acting professor in the vacancy caused by the death of Prof. Albert F. Ganz.

John Hunter, chief engineer of the Union Electric Light and Power Co., has been commissioned by Government officials in charge of the construction of 50 freighters and 77 transports at the shipyards in the Passaic River, Newark, N. J. Mr. Hunter learned the shipbuilding craft in the Clyde yards, Scotland, and has practical experience both in the construction and operation of large draft vessels. He was at one time chief engineer on the Red Star line, and supervised the building of the "St. Louis" and "St. Paul" liners of the American line. He was also chief engineer of the "St. Paul" under Admiral Sigsbee during the Spanish War. The freighters now being built by him will have a capacity of 5000 tons each and the transports will be of the high-speed type, making fifteen knots an hour, and will carry 9500 tons.

THE COAL MARKET

Boston—Current quotations per gross ton delivered alongside Boston points as compared with a year ago are as follows:

ANTHRACITE

	Circular[1]		Individual[1]	
	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago
Buckwheat ..	$4.98—5.20	$2.05—3.20	$7.10—7.35	$3.25—3.50
Rice	4.40—4.65	2.50—2.65	6.65—6.90	2.70—2.95
Boiler	.....	.....	.....	.....
Barley	3.90—4.15	2.20—2.35	6.15—6.40	2.35—2.60

BITUMINOUS

Prices per gross ton for Boston delivery are as follows:

	F.o.b. Mines*		Alongside Boston†	
	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago
Clearfields....	.....	$3.00	.....	$4.25—5.00
Cambrias and Somersets..	.....	3.10—3.85	.....	4.60—5.40

Note—Bituminous not on market.
Pocahontas and New River, f.o.b. Hampton Roads, is $4, as compared with $2.85—2.90 a year ago; on cars Boston price is $8.50—8.75.
*All-rail rate to Boston is $2.60. †Water coal.

New York—Current quotations per gross ton f.o.b. Tidewater at the lower ports* as compared with a year ago are as follows:

ANTHRACITE

	Circular[1]		Individual[1]	
	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago
Buckwheat ..	$3.95—4.65	$2.75	$5.10—5.30	$4.25—4.50
Rice	3.40—3.60	2.20	3.80—4.10	3.00—3.25
Barley	2.90—3.15	1.95	3.00—3.30	2.10—2.25

Quotations at the upper ports are about 5c. higher.

BITUMINOUS

	F.o.b. N. Y. Harbor	Mine
Pennsylvania	$3.65	$2.00
Maryland	3.65	2.00
West Virginia (short rate)	3.65	2.00

Based on Government price of $2 per ton at mine.

*The lower ports are: Elizabethport, Port Johnson, Port Reading, Perth Amboy and South Amboy. The upper ports are: Port Liberty, Hoboken, Weehawken, Edgewater or Cliffside and Guttenberg. St. George is in between and sometimes a special boat rate is made. Some bituminous is shipped from Port Liberty. The freight rate to the upper ports is 5c. higher than to the lower ports.

Philadelphia—Prices per gross ton f.o.b. cars at mines for line shipment and f.o.b. Port Richmond for tide shipment are as follows:

	Line		Tide	
	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago
Buckwheat ...	$2.90	$2.00	$3.80	$2.90
Rice	2.40	1.25	3.40	2.15
Boiler	2.20	1.10	3.30	2.00
Barley	1.90	1.00	2.15	1.90

Pittsburgh—Price of steam coal per net ton f.o.b. mine, Pittsburgh district:

	Nov. 22, 1917	One Year Ago
Slack	$3.00—3.25	$4.50—4.75
Mine-run	3.00—3.25	3.00
¾-in.	3.50—3.75	3.35—3.85

Add 40c. per ton for freight charge to Pittsburgh.

Chicago—Current prices per net ton f.o.b. mines are as follows:

	Counties Williamson and Franklin	Harrisburg Saline and	Smokeless West Virginia	field Spring-	Counties Clinton and Sullivan
Steam lump ..	$2.65	$2.65	$2.70	$2.65	$2.65
Lump	2.65	2.65	2.70	2.65	2.65
Egg	2.65	2.65	2.70	2.65	2.65
Nut	2.65	2.65	2.70	2.65	2.65
No. 1 nut....	2.65	2.65	2.70	2.65	2.65
No. 2 nut....	2.65	2.65	2.70	2.65	2.65
No. 3 nut....	2.65	2.65	2.70	2.65	2.65
No. 1 washed.	2.65	2.65	2.70	2.65	2.65
No. 2 washed.	2.65	2.65	2.70	2.65	2.65
Mine-run	2.40	2.40	2.40	2.40	2.40
Screenings	2.15	2.15	2.20	2.15	2.15

Hocking lump, $2.60; splint lump, $2.40.

Northern Illinois thin vein—Prepared sizes, $2.65; mine-run, $2.40; screenings, $2.15.

St. Louis—Prices pet net ton f.o.b. mines a year ago as compared with today are as follows:

	Williamson and Franklin Counties		Mt. Olive and Staunton		Standard	
	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago	Nov. 22, 1917	One Year Ago
6-in. lump ..	$2.80	$2.75	$2.80*	$2.75	$2.80	$2.50
2-in. lump ..	2.80	2.75	2.80*	2.75	2.80	2.50
Steam egg...	2.80	2.75	2.80*	.....	2.80	2.50
Mine-run ...	2.55	2.75	2.55*	2.75	2.55	2.00
No. 1 nut...	2.80	2.75	2.80*	2.75	2.80	2.50
2-in. screen..	2.30	2.00	2.30*	1.75	2.30	1.75
No. 5 washed	2.30	2.00	2.30*	1.75	2.30	1.75

*Strike.
Williamson-Franklin rate St. Louis, 72½c.; other rates, 57½c.

Birmingham—Current prices per net ton f.o.b. mines are as follows:

	Mine-Run	Lump and Nut	Slack and Screenings
Big Seam	$1.90	$2.15	$1.65
Pratt, Jagger, Corona....	2.15	2.40	1.90
Black Creek, Cahaba ...	2.40	2.35	2.15

Government figures.

[1]Individual prices are the company circulars at which coal is sold to regular customers irrespective of market conditions. Circular prices are generally the same at the same periods of the year and are fixed according to a regular schedule.

PROPOSED CONSTRUCTION

Ariz., Tucson—City has had preliminary plans prepared by C. F. Von Petersdorf, City Engr., for the installation of an electric-lighting plant. Estimated cost, $17,000.

Calif., Oakland—The General Electric Co. has purchased a site of land on Peralta and 16th St., and plans to double the capacity of its plant.

Fla., Geneva—The Osceola Cypress Co., recently incorporated, plans to build a new electric plant at its works on the St. Johns River and the Florida East Coast R.R. E. L. Hunter, Pres.

Kan., Altamont—City will vote soon on the question of erecting an electric-lighting plant here.

Kan., Atchison—The Blair Milling Co. has leased a site of land south of the Union Station and plans to build a power house equipped with generators for the purpose of driving all the milling machinery with electricity.

Kan., Huron—B. R. Hinchman, Lancaster, is having plans prepared for the installation of an electric-lighting system here.

Kan., Kansas City—City will issue $25,000 bonds to extend and improve its electric-lighting plant.

Kan., McCracken—City voted favorably on a $12,000 bond issue for the extension of its electric-lighting system.

Kan., McPherson—City plans an election soon to vote on proposition to erect a transmission line from here to Galva; also to install an electric-lighting system here.

Md., Baltimore—Cochran, Hill & Co., 221 South Howard St., is having plans prepared for the erection of a new 3-story, reinforced concrete and brick power house addition to its plant on 6th St. and Wilkens Ave.

Mass., Gardner—The Central Oil and Gas Stove Co., 205 School St., has had plans prepared by R. E. Coolidge, Arch., 34 Chapin St., Southbridge, for the erection of a 1-story transformer station and a 1-story pumping station addition to its plant.

Mich., Iron River—The Iron River Stambough & Crystal Falls St. Ry., First National Bank Bldg., plans to build a power house and car barn here. C. A. Hutchinson, Ch. Engr.

Neb., Reynolds—City is considering the installation of an electric-lighting plant.

N. J., Jersey City—The Municipal Light and Power Co. has increased its capital stock from $200,000 to $4,000,000; the proceeds will be used in extensive improvements.

N. Y., Buffalo—The Empire Engineering Co., 1042 Marine Bank Bldg., has had plans prepared by McClintock-Marshall Co., Pottstown, Penn., for the erection of a new 50 x 85-ft. power house at the foot of Michigan St.

N. Y., Chenango Forks—The Binghamton Bridge Co., Press Bldg., Binghamton, plans to erect a brick hydro-electric plant here.

N. Y., New York—S. Ransom, 401 West St., has purchased a tract of land adjoining its present works and plans to build a new 3-story boiler shop.

Ohio, Chardon—City Council plans an election soon to vote on a $25,000 bond issue for the construction of an electric-lighting plant.

Ohio, Midvale—The Northern Ohio Traction and Light Co., Hamilton Bldg., Akron, has had plans prepared by F. C. Warner, Arch., 767 Hippodrome Annex, Cleveland, for the erection of a new 25 x 25-ft. power house.

Okla., Haileyville—The Choctaw Power and Light Co. has applied for a franchise to build and operate an electric-lighting and distributing system here.

Okla., Medicine Park—J. Elmer Thomas of Lawton, plans several improvements here, including an electric-lighting plant.

Penn., Morrisville—The Borough Council plans to install a new gas and electric-lighting plant.

Penn., Philadelphia—Philadelphia & Reading R.R., Reading Terminal, plans to build a new 1-story, brick and reinforced concrete power house at Tulip and Emerald Sts. S. T. Wagner, Ch. Engr.

Penn., Stroudsburg—The Stroudsburg Traction Co., Main and Chestnut Sts., plans to increase its capital stock, the proceeds to be used in further extensions and improvements to its plant. F. Adams, Ch. Engr.

Tenn., Ridgley—The Domestic Ridgley Light and Ice Co., recently incorporated with a capital stock of $10,000, plans to build lighting and ice plant. The incorporators are G. S. Riley, J. T. Foster and G. F. Richardson.

Tex., Beaumont—The Beaumont Iron Works, West Crockett St., will install new machinery, including several electric transformers in its plant.

Tex., Jefferson—The Jefferson Light and Ice Co. plans to install new equipment, including a new electric motor.

Tex., San Marcos—The San Marcos Utilities Co. plans to improve its electric-lighting and water-works plants. Estimated cost, $20,000.

Wash., Oroville—The Okanogan Valley Power Co., 521 1st Ave., Brewster, will build an electric transmission system here. J. E. Brayton, Brewster, Gen. Supt.

Wash., Seattle—The Standard Boiler Works, 36 West Connecticut St., plans to build a 1-story, 64 x 160-ft. brick boiler house. L. P. Ingram, Arch., 1503 10th Ave., W., prepared plans.